THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

VOL. 64 OCTOBER, 1950 No. 4

THE USE OF RADIOACTIVE PHOSPHORUS IN THE TREATMENT OF CARCINOMA OF THE BREAST WITH WIDESPREAD METASTASES TO BONE*†

By HYMER L. FRIEDELL, M.D., *and* JOHN P. STORAASLI, M.D.

CLEVELAND, OHIO

IN 1942, one of us (H.L.F.) treated a patient, aged forty-seven, with widespread osseous metastases arising from carcinoma of the breast who was referred to the service of Dr. Robert S. Stone‡ at the University of California Hospitals, San Francisco, California. A radical mastectomy had been performed in 1937 and when the patient first presented herself in 1942 osseous metastases were demonstrated in the ribs and spine. Because of promising evidence in animals that selective deposition might be obtained with radiophosphorus, an effort was made to treat this patient by the intravenous administration of P^{32}. In February, 1942, the patient received a total of 20 millicuries§ in a period of approximately one month. The material was administered at regular intervals in 2 mc. doses as Na_2HPO_4. There was no immediate untoward effect following the treatment but within a period of six weeks severe hematopoietic depression appeared. The red blood cell count which was originally 3.9 million cells per cubic millimeter dropped to 1.9 million. The white blood cell count which was originally 4,800 per cubic millimeter prior to treatment dropped to 350 cells at its lowest point. During this interval the patient received supportive measures which consisted primarily of transfusions, and gradual recovery from this severe disturbance occurred.

By March, 1943, the patient had gained approximately 25 pounds. She had been able to resume some of the activities which she had been forced to give up because of severe bone pain and generalized weakness. Roentgen examinations indicated definite regeneration of bone and apparent arrest of any further extension. There were, however, obvious areas of metastatic involvement still present. At this time her hemoglobin was 85 per cent, red blood cell count 4 million cells per cubic millimeter, and a

‡ We are indebted to Dr. Robert S. Stone and Dr. B. V. A. Low-Beer of the Department of Radiology, University of California, San Francisco, for permission to cite this case.

§ The radioactive phosphorus was produced on the 60 inch cyclotron and prepared and assayed at the Crocker Radiation Laboratory in Berkeley, California.

* From the Department of Radiology, University Hospitals of Cleveland, Western Reserve University. Presented at the Fiftieth Annual Meeting, American Roentgen Ray Society, Cincinnati, Ohio, Oct. 4–7, 1949.

† Supported in part by a grant from the Elsa U. Pardee Foundation.

number of white blood cell counts showed these to be at normal levels.

In September, 1944, there was evidence of further extension of the bone involvement as demonstrated by roentgen examination and the patient was given a second course of phosphorus consisting of 9.4 mc.* distributed over a period of twenty-four days. Severe hematopoietic depression again occurred and three transfusions were given. For about two years following this course of treatment the patient was in comparatively good health although there was a progressive increase in osseous pain as a result of the numerous metastases and her course was slowly but unmistakably retrogressive. The patient, however, was still alive in January, 1947, and because of further progression of the disease a third course of treatment, consisting of 9.5 mc. administered over a period of thirty-seven days, was given. There were now pathological fractures of the right hip and right clavicle, and immobilization in plaster was necessary. In July, 1947, the patient received testosterone propionate, and acceleration of the calcification of the involved bone was observed. It was now difficult to evaluate the response from P^{32} since large doses of testosterone were administered during the last portion of her illness and the accelerated recalcification is probably attributable to the androgen. However, the radiophosphorus may have contributed to the regeneration of bone since there was definite regression of the osteoclastic changes following the first course of P^{32} in 1942. The patient died in February, 1948, and an autopsy was performed which revealed widespread evidence of disease. All the viscera were involved by tumor and unmistakable tumor invasion in the osseous system was present.

The satisfactory progress which this patient appeared to show following the first and second courses of radiophosphorus, with evidence of definite subjective improvement, as well as objective changes in the roentgenogram, encouraged us to attempt this form of therapy in additional cases of widespread osseous metastases in breast cancer. In the past two years, therefore, treatment with P^{32} has been attempted in 12 cases which will be described in this report.

The concept of treating malignant disease with internally distributed radioactive elements has received great impetus from the invention of the cyclotron, and, more recently, from the development of nuclear reactors which are under the auspices of the Atomic Energy Commission. The idea of using internally distributed radioactive elements, however, did not arise with the production of artificial isotopes, since previous attempts to use natural radioactive elements in this manner had been made. The rationale of treating any disease with internally distributed radioactive elements is based primarily on the desire to obtain selective irradiation of a specific abnormal tissue, or group of cells, by permitting the radioactive element to seek selectively the abnormal growth wherever it may exist. P^{32} was first used for malignant disease by Lawrence and his colleagues[11] in 1936 with the application of radiophosphorus for leukemias and lymphomas. It had been shown, both in animals and in humans, that such selective irradiation indeed does occur in the case of the leukemias and certain lymphomas.[5,13]

The utilization of P^{32} for the treatment of widespread metastases of bone arising from carcinoma of the breast is supported by several considerations. It is known that phosphorus, when introduced into the blood stream in the form of readily diffusible and ionizable phosphate, will be available to all tissues, and those cells which utilize this element in their metabolic processes will rapidly take it up. It has been clearly demonstrated that there is a definite differential absorption rate on comparing rapidly growing or embryonic tissues with those which have attained the adult

* The second and third courses of radiophosphorus were administered by Dr. B. V. A. Low-Beer of the University of California Hospitals, San Francisco, California.

state. Surveys have demonstrated that more P^{32} is present in rapidly growing cells as compared with normal cells. Marshak[14] has shown that malignant tumor cells accumulate more P^{32} than normal cells and that proportionately the nuclei of malignant cells contain considerably more of the radioactive elements than the nuclei of normal cells. This differential uptake is not limited to malignant cells alone but is also true of rapidly multiplying tissue in general. In a study of transplanted Brown-Pearce tumors, Forssberg and Jacobsson[7] found that metastatic tumor nodules took up as much P^{32} as other active organs (spleen, liver, kidney) and about five times as much as less active tissue (diaphragm, omentum, lymph nodes, pleura). Forssberg[6] also found that bone metastases took up considerably larger amounts of P^{32} per gram of wet weight than corresponding weight of normal bone. Lawrence and his associates[8,10,12,16] have demonstrated that leukemias and lymphomas take up P^{32} in greater amounts than normal tissues of comparable character. Similar findings were reported by Kenney[9] in a study of P^{32} uptake by primary neoplasms and metastatic tumors in lymph nodes. In our own cases there was also selective uptake, as will be seen later.

The deposition of radioactive phosphorus is dependent upon a number of factors, the most important of which appear to be:

1. *The metabolic turnover rate.* This rate determines the rapidity with which a specific cellular structure may reach equilibrium with its milieu. It is dependent upon (a) the specific metabolic activity of the tissue and (b) the rate of growth of the tissue. The metabolic activity and rate of growth are closely intertwined and often inseparable.

2. *The normal requirements for phosphorus, or proportion of phosphorus ordinarily present in the tissue.* This often serves as a gross index of the prospective deposition of P^{32}.

3. *The rate and ease of transfer of phosphorus across the cell membrane, or cell permeability to P^{32}.* This is concerned with the special characteristics of the cellular envelope, pH of the cell environment, concentration of radiophosphorus in the immediate cell milieu, etc. We believe that bone metastases often have higher concentrations of radiophosphorus than soft tissue metastases because the metastatic tumor in bone is surrounded by interstitial tissues which retain the P^{32} for long periods of time, thereby making radiophosphorus available to the tumor more readily and for longer periods.

4. *The nature of the phosphorus compound.* Since radioactive phosphorus must be brought to the cell by the blood stream across numerous membranes, the character of the P^{32}-containing compound—that is, whether it is readily ionizable, bound to organic compounds, or insoluble—determines its uptake by any specific tissue. To reach tumor cells the phosphorus must obviously be of a soluble nature, since insoluble forms such as chromic phosphate are removed quickly from the blood stream by the reticuloendothelial system and, in general, have no opportunity to continue beyond the liver and spleen and portions of the bone marrow.

If, theoretically, all tissues of the body, normal and neoplastic, had the same type of phosphorus-containing constituents and the same turnover rate, the use of P^{32} would be entirely without rationale and would correspond to external general body irradiation with roentgen rays. It is well known and well established, however, that normal cells of various tissue structures have different metabolic and turnover rates and different phosphorus requirements. When P^{32} is introduced into the body, differing levels of radioactive phosphorus will thus occur in the different tissues. In addition to this, tissues, in which replacement is rapid (thus producing a rapid metabolic uptake of all the elements and compounds which enter into the constituent of the cell), approach equilibrium much more quickly than cells of lower activity and thus achieve a higher level of radioactive

phosphorus and a correspondingly higher level of radiation than the less active cell.

If we assume a constant amount of P^{32} in the vascular and intracellular fluid, then the tissue cells in any organism will have the same specific activity of P^{32} (the ratio of active to inactive phosphorus) when the organism finally reaches equilibrium. Before equilibrium is reached, however, those tissues having the more rapid metabolic rate and turnover will contain more P^{32} or, more precisely, a higher specific activity of P^{32} will exist. If no difference in the metabolic and turnover rate exists, then the rate at which equilibrium is approached is the same for all tissue and specific activity is the same for all tissues at all times.

In the actual therapeutic application of radiophosphorus certain information is essential for orientation by this means of treatment.

1. *The Physical Characteristics of* P^{32}.*,† P^{32} has characteristics which are readily adaptable to biologic use. The half-life is 14.3 days. A beta particle is emitted which has a peak energy of 1.69 mev. and an average energy of 0.7 mev. The peak range in soft tissues is, therefore, about 8 mm. with the average range approximately 2 mm. The radiation is, therefore, confined primarily to the tissue in which the phosphorus is deposited. If information is available as to the number of microcuries present per unit mass of tissue, it is possible to calculate the roentgen equivalents for complete decay. One microcurie in 1 gram of tissue on complete decay will produce 857 rep (roentgen equivalent physical).

2. *Phosphorus Content of Normal Tissue.* The normal phosphorus stores of the various tissues of the body are an important consideration in the feasibility of treatment with ionizable P^{32}. Since the stores of phosphorus in the tissues generally reflect the need for phosphorus, the amount of P^{32} taken up in tissue will be directly related to this need. Bone, therefore, contains more phosphorus than any other tissue. Figure 1 indicates the character of the distribution of intraperitoneally administered P^{32} in the skeleton and the soft tissues over the first two weeks.

TABLE I

PER CENT INTRAPERITONEALLY INJECTED P^{32} PRESENT IN VARIOUS TISSUES OF ALBINO RATS

Organ	1 Day	7 Days	14 Days
1. Skeleton	45.0	41.5	34.2
2. Muscle	19.4	10.8	16.2
3. Digestive tract	14.4	2.5	4.2
4. Liver	9.2	1.3	1.8
5. Skin	5.4	1.4	2.0
6. Brain	0.13	0.20	0.20

Cohn and Greenberg[3] found that retention of P^{32} per unit fresh weight in various tissues decreased in the following order: bone, liver, intestine, heart, kidney, lung, muscle, skin and brain. After ninety-eight days, 92 per cent of the retained phosphorus was present in the skeleton. Studies made on rats in which amounts of P^{32} were considerably greater than tracer doses, gave the distribution as seen in Table 1.

3. *The Retention of Phosphorus in the Tissue, or Rate of Loss from the Body.* In order to determine the effectiveness of specific dosages it is important to establish if possible, the amount of material actually

* P^{32} was first produced in the laboratory of E. O. Lawrence by the bombardment of red phosphorus in the external target chamber or an iron phosphide probe placed directly in the deuteron beam (d, p reaction). It is also possible to produce phosphorus in the piles from sulphur by the n, p reaction producing essentially carrier-free P^{32}.

† Radioassay of P^{32}. Shipments of P^{32} from Oak Ridge are in the form of aqueous solutions of H_3PO_4 at pH 3–5. These samples, properly diluted, are evaporated on a silver disc so as to closely approximate the size and activity of the deposit on the RaD+E standards distributed by the National Bureau of Standards. These samples are then counted along with the RaD+E standard and absorption curves run for both. A value of the count at zero absorber is obtained by extrapolating the above curves to zero, allowing for the thickness of the G-M tube window and additional air absorber. By comparing the zero absorber counts of the P^{32} and the RaD+E standard, an absolute millicurie value is obtained for the P^{32}. This value must be corrected, however, for the difference in backscatter from silver of the beta particles of P^{32} and the RaD+E standard. This correction, when applied, reduces the above absolute millicurie value by 7 per cent. Results obtained by this method generally check with the assay of the Oak Ridge National Laboratories values to within 5 per cent. Comparisons with the National Bureau of Standards check samples showed our millicurie to be almost exactly equal to that of the National Bureau of Standards. Deviation was not more than 1 per cent.

distributed in the tissue. In patients it is difficult, if not impossible, to obtain tissues for assay at opportune times since the tissues must be available promptly following the administration; otherwise, excretion and natural decay reduce the amount to a very low level. It has been found in leukemias that patients excrete 5 to 25 per cent of the P^{32} in the first four to six days when the material is administered intravenously, and 15 to 50 per cent in the first four to six days when given by mouth. In rats, which closely approximate the retention and excretion rate in humans, and where it was possible to follow accurately the retention in the various tissues, the retention and distribution in skeletal tissue as compared to soft tissue and the rate of loss in the excreta is shown in Figures 1 and 2. It may be observed that at the end of two weeks, 46 per cent of the administered dose is excreted, and of the remaining, 20 per cent is in the viscera and musculature and 33 per cent in bone. The ratio of bone deposition to soft tissue deposition continues to increase with time since the biologic half-life for soft tissue after equilibrium is about nine days and that for bone is slightly over ten days (see Fig. 3). The figure for bone has added significance when one recognizes that bone comprises only 10 per cent of the body weight. In calculating dosage, the biologic half-life,

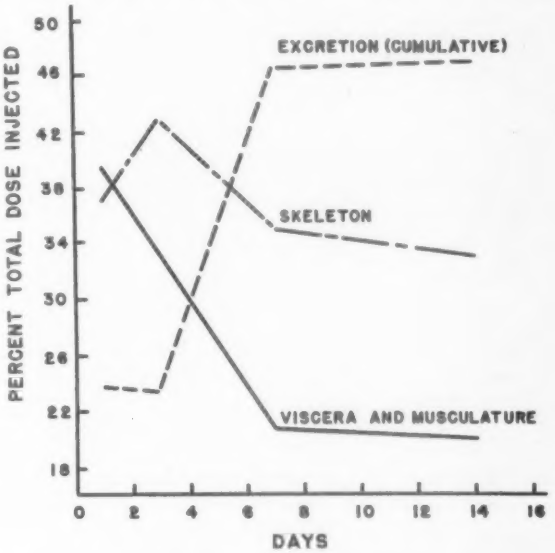

Fig. 1. The curve shows the distribution of retained P^{32} in skeleton and viscera and the amount excreted for intervals throughout fourteen days. The amount retained in the skeleton progressively increases beyond the fourteen day period.

which is a combination of the excretion rate and the physical decay rate, is actually more helpful than the physical decay rate alone.

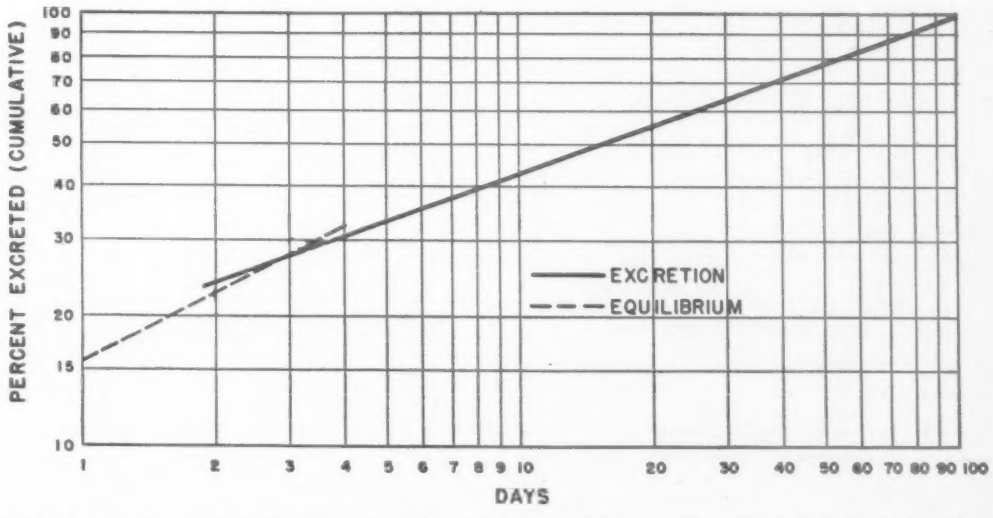

Fig. 2. The rate of excretion changes after the third day. Prior to this, the excretion is definitely more rapid and the curve has been arbitrarily called the equilibrium curve.

4. *The Radiation Effect of P^{32}.* The effect of P^{32} must be evaluated for each separate system in the body. However, a general concept of the radiation effects may be obtained from experimental and clinical uses of this material. In a series of rats it has been shown that 4.5 microcuries of P^{32} administered intraperitoneally results in death of 50 per cent of the animals in a fifteen day period, the animals dying with severe leukopenia, thrombocytopenia and anemia. As is well known, the hematopoietic system is primarily affected and in our own cases Figure 4 shows the effect of P^{32} on the white and red blood cell count. In rats it was found that 0.7 microcurie per gram of body weight (0.7 millicurie per kilogram) produces a maximum depression of 50 per cent in the total white blood cell count in about ten days. Studies of the radiation effect on skin have been made by Osgood *et al.*[15] who found that an erythema may be produced by the direct application with a dosage of 34 microcurie hours per square centimeter.

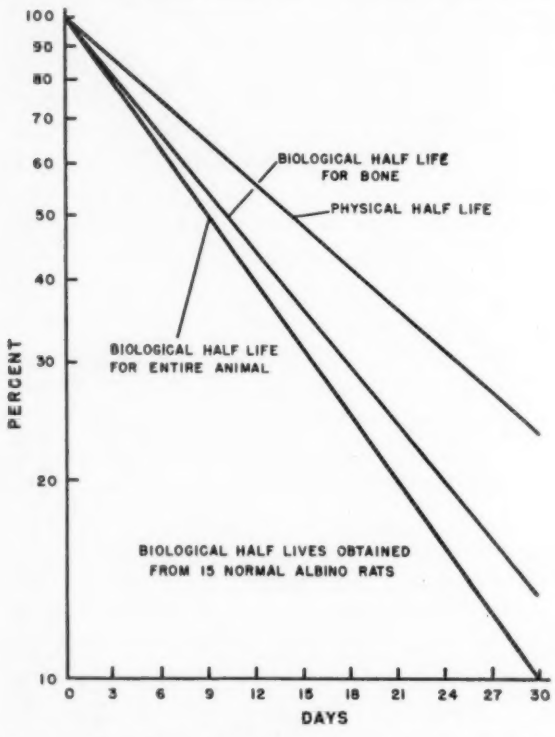
PERCENT
DAYS
BIOLOGICAL HALF LIFE FOR BONE
PHYSICAL HALF LIFE
BIOLOGICAL HALF LIFE FOR ENTIRE ANIMAL
BIOLOGICAL HALF LIVES OBTAINED FROM 15 NORMAL ALBINO RATS

Fig. 3. The biological half-life is valid only after the third day, at which time 62 per cent of the injected dose was retained. It is a composite curve of the amount excreted plus the decay of the P^{32}.

It is clear, therefore, that a useful background of information on the radiation changes produced by P^{32} has accumulated for a long time and serves to fortify the therapeutic trials in the cases reported here.

CLINICAL STUDY

In this particular group of patients only those cases were treated in which external radiation was impossible or extremely difficult. Since intensive treatment with radiophosphorus is not without complications, it was necessary to make careful selection of patients for treatment.

Basis of Selection.

1. Previous mastectomy with confirmed evidence of breast cancer. All patients had had previous mastectomy and the diagnosis has been definitely made histopathologically. Since the series of cases is small, we have made no attempt to differentiate the various types of breast carcinoma.

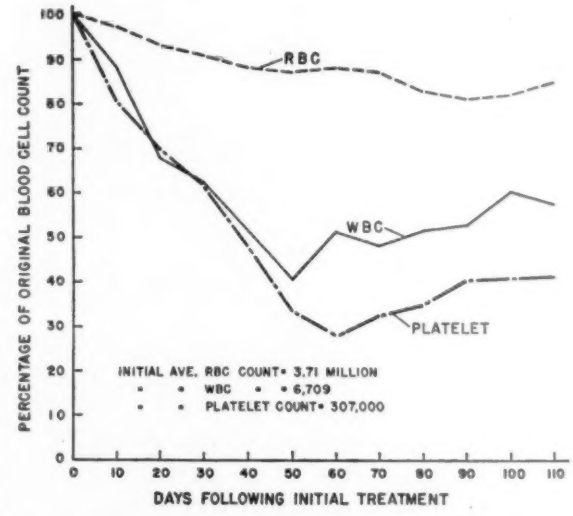

Fig. 4. This figure indicates the rate and character of the depression observed in the peripheral cell count after the 110th day. The red blood cell, white blood cell and blood platelet count continue to rise but never quite reach the original level.

2. Widespread osseous disease. No case was included in which only one bone, as demonstrated roentgenologically, was in-

volved. Practically all the patients were in a very late stage of the disease since we endeavored primarily to survey the effect on the most advanced cases. All cases, with the exception of one, were being given terminal care at the time this treatment was instituted.

3. Severe and continuous bone pain. Since this symptom was used as one of the criteria for therapeutic response, only those cases were chosen that exhibited great distress. This made it possible to more readily determine any change in this subjective finding.

*Plan of Treatment.** The plan of treatment was not fixed but was held within fairly narrow confines. It was dictated in part by the original dose of P^{32} which was given to the patient who was treated in 1942. We were also guided by the amount of radiophosphorus found necessary for the effective treatment in leukemic patients. In general, the dosage employed for leukemias was increased twofold and an attempt was made to administer 3 mc. per 10 kilograms of body weight—the material to be given in 2 mc. doses at five day intervals. There were minor variations from this plan, the deviations occurring because of undue hematopoietic depression. In our series, we actually administered 18.2 mc., on the average, to each patient, the dosage being distributed over a period of forty days.

Therapeutic Response. The patients were carefully observed throughout their course of treatment and at periodic intervals thereafter. Prior to the treatment the skeletal system of each patient was surveyed with roentgenograms. The routine studies included examinations of the skull, dorsal and lumbar spine, ribs and pelvis. These examinations were repeated at three month intervals, or sooner if such studies appeared essential. The peripheral blood was carefully studied at weekly intervals during the course of treatment and periodically thereafter. A complete examination of the blood electrolytes was not done, but the levels of serum calcium, phosphorus and alkaline phosphatase were determined wherever possible.

Table II tabulates the pertinent features of these cases and indicates the progress following treatment. As may be observed, the patients ranged in age from thirty-three to sixty-nine years, with an average of forty-eight years. Three patients were pre-menopausal. The remainder were beyond the menopause. The regression in the severity of the bone pain was most striking and occurred in all but 2 of the cases. In these 2 instances the patients had become addicted to morphine. It is possible that this addiction masked any relief of pain. Relief from pain was never complete, but there were long intervals without discomfort. The improvement was apparent well before the end of treatment, but usually did not appear until more than half of the radiophosphorus had been administered. It is somewhat difficult to evaluate changes in a subjective finding, and it is impossible to eliminate the psychic element. However, the uniform response observed with regard to relief of pain appears significant. There was recovery in various measures from the weakness and general malaise which was present in all cases, and the 2 patients (Cases II and VIII) in which bone regeneration was demonstrated were able to reassume many of their previous activities. Patient VIII is actively working.

Objective improvement was determined primarily by the appearance of the bone lesions on roentgen studies. The osseous lesions were widespread and involved the usual sites (pelvis, ribs, spine and skull). Most of the metastases were osteolytic. One case was osteoblastic and 2 cases showed some element of osteoplastic changes in addition to the marked osteolytic invasion. As noted above, 2 of the cases (Cases II and VIII) showed definite recalcification in sites which were de-

* The P^{32} was administered as Na_2HPO_4, buffered to a pH of 7. A small amount of inert phosphate was added so that when actually administered the radiophosphorus was not entirely carrier free and 25–50 micrograms of Na_2HPO_4 was present for each millicurie of radiophosphorus.

TABLE II

SUMMARY OF CLINICAL DATA OF TWELVE PATIENTS

Case	Age	Duration of Bone Metastases Before Treatment	Osseous Metastases as Demonstrated by Roentgen Ray	Symptoms*		Hemogram before Treatment				Blood Chemistry	P^{32} Dosage
				Bone Pain	Weakness	Hgb. per cent	Erythrocytes per mil cu. mm.	Leukocytes per cu. mm.	Platelets		
I M.R.	50	8 mo.	Extensive osteolytic lesions of skull, ribs, spine, pelvis, femora	++++	+++	77	3.91	7000	432,000	P=4.6 mg. Ca 10.4 mg. S.phos.alk. 8.5 units	16 mc. in 36 days
II F.R.	48	5 mo.	Extensive osteolytic lesions of skull, ribs, spine, pelvis, femora	++++	+++	81	4.15	5500	400,000	P=3.1 mg. Ca 9.6 mg. S.phos.alk. 17.6 units	18 mc. in 32 days
				+++	++	71	3.56	4400	139,000		12 mc. in 36 days
III L.C.	57	Unknown	Extensive osteolytic lesions of skull, ribs, spine, pelvis	+++	++	72	3.81	6250	205,000	P=4.8 mg. Ca 11 mg. S.phos.alk. 11 units	16 mc. in 58 days
IV A.M.	38	4 mo.	Primarily osteolytic, but also osteoblastic lesions of skull, ribs, spine, pelvis, femur	++++	+++	90	4.60	5600	232,000	P=4.8 mg. Ca 10.7 mg. S.phos.alk. 12.6 units	17 mc. in 30 days
				+++	++	85	4.40	4800	530,000		14 mc. in 25 days
V O.P.	33	2½ mo.	Extensive osteolytic lesions of ribs, spine, pelvis, scapula, clavicle, femora	+++	++	79	4.40	11500			22.3 mc. in 38 days
VI A.J.	41	18 mo.	Primarily osteoblastic lesions of skull, ribs, spine, pelvis, humeri, femur, radius	++++	+++	70	3.38	8500	275,000	P=4.5 mg. Ca 11.2 mg. S.phos.alk. 13 units	14 mc. in 46 days
VII M.T.	60	9 mo.	Primarily osteolytic metastases with some elements of osteoblastic changes in skull, ribs, pelvis, spine, clavicle	+++	++	85	4.10	6060	250,000	P=3.8 mg. Ca 10.8 mg. S.phos.alk. 7.9 units	18 mc. in 60 days
VIII E.P.	36	2 mo.	Purely osteolytic lesions of left 11th rib and 3rd lumbar vertebra	+++	+	66	3.50	4700	219,000		16 mc. in 36 days
IX I.D.	47	12 mo.	Purely osteolytic lesions of ribs, spine, pelvis, left femur	++++	++	63	3.26	9900	204,000		16 mc. in 33 days
X Z.P.	46	6 mo.	Extensive osteolytic lesions of ribs, spine, scapula, pelvis, femur	++++	+++	84	4.70	10000	600,000	P=3.9 mg. Ca 10.8 mg. S.phos.alk. 30.3 units	18 mc. in 65 days
XI A.B.	46	6 mo.	Osteolytic lesions of skull, ribs, pelvis, spine, femora	+++	++++	61	2.80	6500			14 mc. in 44 days
XII E.W.	69	2 mo.	Osteolytic lesions, of ribs, spine, pelvis, femora	++++	+++	70	3.80	5600	250,000	P=4.7 mg. Ca 14.3 mg. S.phos.alk. 8.3 units	17 mc. in 22 days
Average	48	6–8 mo.					3.88	8800	307,000		18.2 mc. in 41.5 days

stroyed by metastatic invasion. Beginning calcification was evident within a period of three months following the course of treatment. In Case II, the recalcification, though marked, was incomplete, and after an interval of almost a year, during which time the osseous metastases appeared to have been arrested, further extension of the

TABLE II—*continued*

SUMMARY OF CLINICAL DATA OF TWELVE PATIENTS

Hemogram following Treatment Maximum Depression					Effect of P^{32} on Symptoms					
Hgb. per cent	Erythrocytes per mil cu. mm.	Leukocytes per cu. mm.	Platelets	Complications	Bone Pain	Weakness	Roentgen Findings following Treatment	Duration of Life after Treatment	Autopsy Findings	Remarks
89	4.59	3900	250,000	None	++	++	Progression, especially in skull	5 mo.	Widespread involvement of bone, spleen, liver, pleura, peritoneum, lymph nodes, adrenal, pancreas	Patient had compression fracture of L-3. Was in plaster spica
75	3.99	2000	200,000	None	+	o	Recalcification of many of the metastatic lesions	13 mo.		Patient received several doses of testosterone several months before treatment with P^{32}. X-ray showed no improvement after androgen
41	3.16	1000	40,000	Purpura	+	++	Progression in pelvis. No progression in other sites	6 mo. Total of 19 mo.	Widespread involvement of bone, liver, spleen, adrenals, pancreas, skin, left breast, heart, lymph nodes, peritoneum, dura	
69	4.14	2100	50,000	Purpura	++	+	Progression in all sites	5 mo.	No autopsy	Progressively downward course. Moderate relief of pain
96	4.90	1500	37,000	Purpura	+	o	Progression	3 mo.		Good responses to first course
88	4.40	2000	13,000	Purpura	++	++	Progression	2 mo. Total of 5 mo.	No autopsy	
62		220		Purpura	+	++	None	1 mo.	Widespread involvement of bone, lung, pleura, liver, peritoneum	Patient had marked pulmonaryinvolvement with massive pleural effusion bilaterally
69	2.85	1100	260,000	None	+++	+++	Progression	6 mo.	Widespread involvement of bone, liver, spleen, pleura, adrenal, pancreas, peritoneum	Patient was addicted to opiates. Difficult to evaluate
70	3.00	2350	150,000	Purpura	++	++	Slow progression	5 mo.	Widespread involvement of bone, liver, spleen, pleura, adrenals, pancreas, lymph nodes, peritoneum	Patient was addicted to opiates. Difficult to evaluate
57	2.97	1700	64,000	Purpura	o	o	Recalcification of rib lesion	Living 12 mo.		Patient had compression fracture 3rd lumbar vertebra prior to P^{32} therapy. Treated with x-ray localized to L-3
	4.20	3900	160,000	None	++	++	Progression of all lesions	3 mo.	No autopsy	Had roentgen therapy to various involved areas with little effect
85	4.30	4100	110,000	None	++++	++	None Too early	1 wk.	Widespread involvement of bone, liver, spleen, skin, pleura, peritoneum, kidney	Patient died too soon for evaluation. Addicted to opiates
48	2.17	1800	10,000	Purpura	++	+++	Progression	6 wk.	No autopsy	Patient had marked anemia before treatment started. Refused to be hospitalized for transfusions
51	2.21	1100	10,000	Purpura	+	+	Recalcification of one rib lesion. No progression in other areas	6 mo.	No autopsy	Except for relief of pain, course seemed progressively retrogressive
	3.15	2000	90,000					5.4 mo.		

disease became apparent. In addition to the osseous involvement, extension to the soft tissue and viscera was also becoming evident. In the other (Case VIII), there is extensive regeneration of bone in the eroded rib. In 2 others (Cases IV and XII), there appeared to be an arrest in the progress of the bone invasion and the lesions

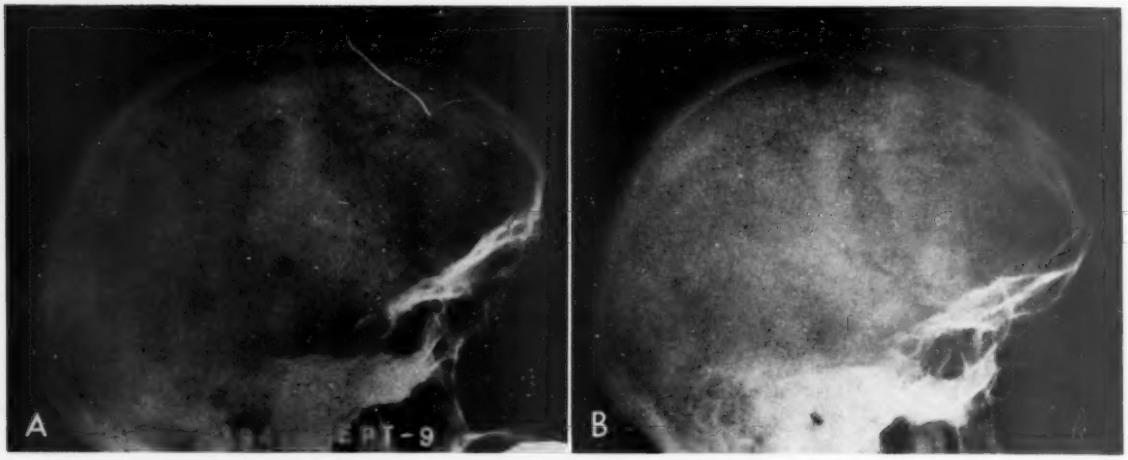

FIG. 5. (*A*) Roentgenogram of the skull (Case II) made on September 9, 1947, showing osteolytic lesions of the skull. This examination was made immediately prior to treatment with P^{32}. (*B*) Roentgenogram of the skull (Case II) made on January 2, 1948, approximately three months following completion of therapy. There has been marked recalcification. This is most prominent in the parietal bone. There is still evidence of metastatic invasion, however, as may be seen in the frontal area.

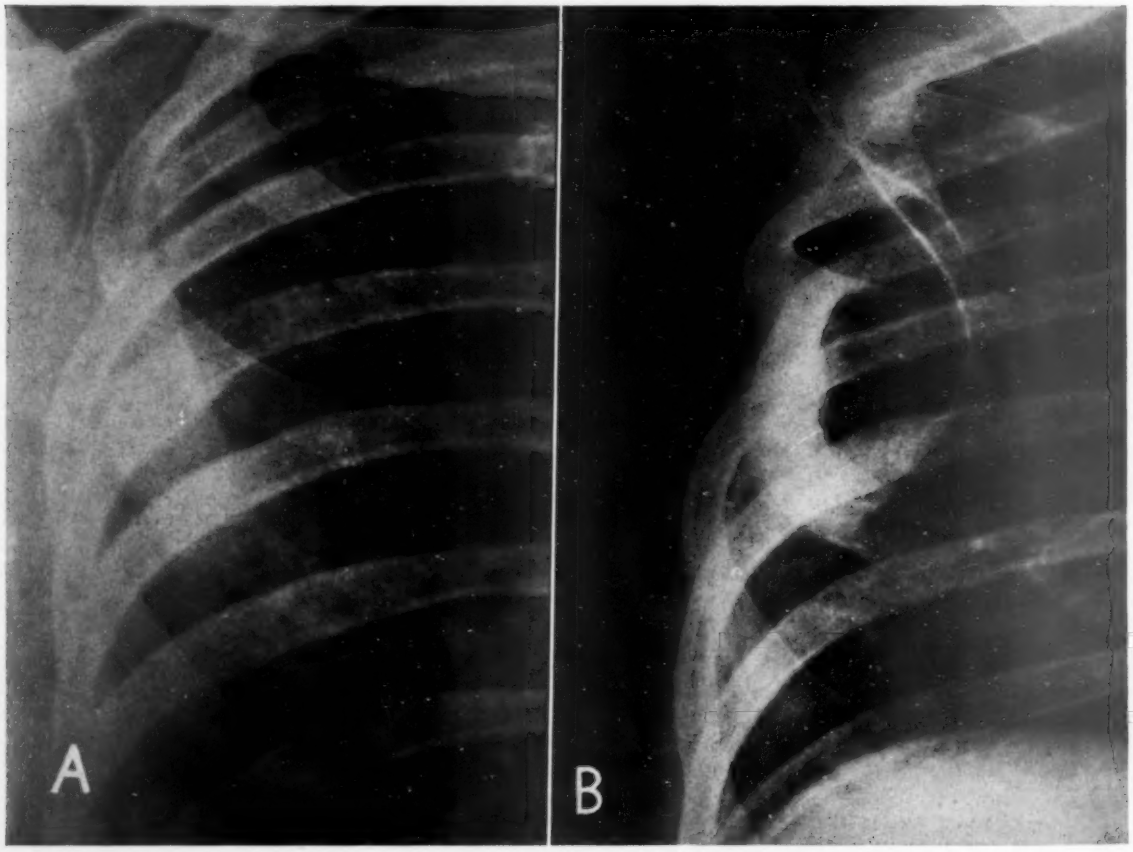

FIG. 6. (*A*) Roentgenogram of the ribs on the right (Case II) indicates extensive destruction of the fourth rib. Metastatic lesion of the sixth rib is also clearly demonstrated. This film was made on September 9, 1947, immediately prior to treatment with P^{32}. (*B*) Roentgenogram of the right ribs (Case II) made on September 30, 1948, approximately eleven months following initial course of radiophosphorus. The fourth rib has shown marked and extensive recalcification. There has also been recalcification of the sixth rib.

remained unchanged by roentgen examination. There was equivocal evidence of bone regeneration in some of the lesions in these 2 cases. The remaining 8 cases showed progressive bone destruction and spread of the metastatic lesions, but with surprisingly little additional discomfort.

Figures 5, 6 and 7 indicate the character of the recalcification and bone healing following treatment in Case II. Figure 8 shows the changes following treatment in Case VIII. Similar observations have been made following the use of endocrines in cases of widespread breast cancer and response to treatment with P^{32} seems to parallel that occurring after the use of estrogens. A recent report by Adair *et al.*[1] and by the Subcommittee of the Council on Pharmacy and Chemistry of the American Medical Association[4] indicates the efficacy of endocrine treatment.

We were unable to establish any definite increase in longevity. Our figures indicate that the patients lived, on the average, approximately five months following completion of therapy. We have been unable to obtain satisfactory figures for a comparable group of patients which would permit any comparison. However, the patient treated at the University of California Hospitals was alive for a period of six years following treatment, and in our own series 1 patient lived nineteen months and 1 patient has now been living twelve months and is symptomatically well.

As may be observed in Table II, satisfactory assays of serum calcium, phosphorus and phosphatase were not obtained in all cases. The only significant finding, which has been also observed by others, was an elevation of the alkaline phosphatase, indicating some osteoplastic activity which was associated with the widespread metastatic bone disease.

Complications of Treatment. The complications arising from the treatment with radiophosphorus stem primarily from the severe disturbance of the hematopoietic system. Since the bone marrow is extensively irradiated this is not unexpected, and the peripheral blood quickly reflects the changes produced in the bone marrow. The red blood cells, white blood cells and platelets are severely depressed, the white blood cells showing the most prompt recession. Figure 4 shows the character of the hematopoietic change following therapy. As may be observed, the average white blood cell count prior to treatment was 8,800 per cubic millimeter, the average red blood cell count 3.88 million per cubic millimeter, and the average platelet count slightly over 300,000 per cubic millimeter. After the maximum depression following therapy, the average white blood cell count was reduced to 2,000 cells per cubic millimeter, the red blood cell count was 3.15 million cells per cubic millimeter, and the platelet count was 90,000 per cubic millimeter.

In the first patient (treated at University of California Hospitals), the lowest white blood cell level to be observed was 350 cells per cubic millimeter. This occurred approximately three weeks following completion of therapy, but within a period of three months the peripheral white blood cell count was at approximately normal levels (9,900 cells per cubic millimeter). In our series, Case V showed a drop in the white blood cell count to 220 cells per cubic millimeter. The white blood cell count was rising at the time the patient died. (Several white blood cell counts were obtained above 1,000 cells per cubic millimeter.) Death was probably not directly related to the severe drop in the white blood count since autopsy revealed an extreme degree of invasion by metastatic tumor. There was no evidence of widespread infection which might be expected from the low leukocyte count.

The hemoglobin and red blood cell levels were similarly affected, but the extent and rate of decrease was much less marked than the drop observed in the number of white blood cells. When platelets dropped to levels of 50,000, hemorrhagic tendencies of variable degree appeared, but recovery was fairly prompt with the return of the platelets to higher levels.

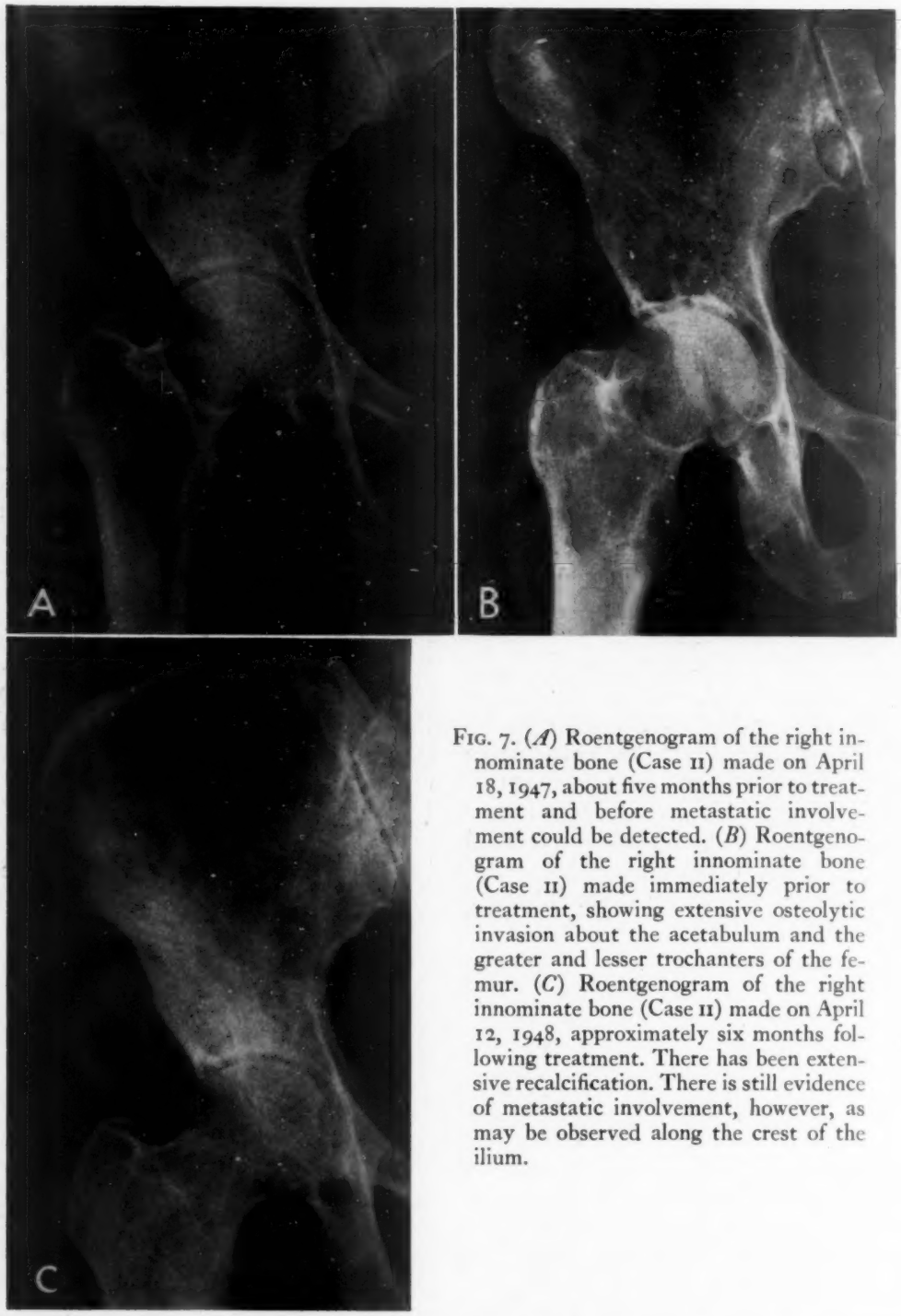

Fig. 7. (*A*) Roentgenogram of the right innominate bone (Case 11) made on April 18, 1947, about five months prior to treatment and before metastatic involvement could be detected. (*B*) Roentgenogram of the right innominate bone (Case 11) made immediately prior to treatment, showing extensive osteolytic invasion about the acetabulum and the greater and lesser trochanters of the femur. (*C*) Roentgenogram of the right innominate bone (Case 11) made on April 12, 1948, approximately six months following treatment. There has been extensive recalcification. There is still evidence of metastatic involvement, however, as may be observed along the crest of the ilium.

The anemias, which were moderate, and the leukopenias, which were often severe, were not particularly distressing. When severe leukopenia occurred (less than 2,000 cells per cubic millimeter), antibiotics were administered as a precautionary measure against infection. The anemias were occasionally treated by transfusions, although the red blood cell count will gradually increase from its lowest levels. The

subcutaneous hemorrhages, as a result of the severe diminution of the platelets, appears to be the most difficult side effect to handle, but with the possible use of protamine and toluidine blue, as suggested by Allen *et al.*,[2] severe hemorrhagic tendencies might be overcome during the intervals at which the platelets are at their lowest levels.

Cessation of menses was observed in 2 of the 3 pre-menopausal patients. The third patient did not live a sufficiently long period to permit this observation. Patient VIII, who is still living, has been experiencing menopausal symptoms. Since routine sterilization is advocated by many in pre-menopausal patients who show evidence of spread beyond the breast, it is possible that radiophosphorus might be particularly useful in the pre-menopausal patient with widespread bone lesions.

Postmortem Examination. In the 6 patients in which postmortem studies were obtained, there was evidence of widespread disease throughout, involving the viscera, lungs, lymphatics and the osseous system. In Case II, in which roentgen examination had demonstrated definite improvement, there was recalcification and regeneration of bone (ribs, pelvis and skull). However, there were adjacent areas which indicated unchecked disease. It was not possible in all cases in which postmortem examinations were obtained to assay the tissues for retained radiophosphorus since death occurred in some instances at long intervals after the P^{32} was administered and accurate measurements could not be made because of the decay of the material. We were able, however, to demonstrate selective uptake by tumor tissue, and Figures 9*A* and 9*B* (Case X), which show a radioautograph of femur invaded by metastatic carcinoma, clearly demonstrate such selective deposition. Table III, which indicates the assay of P^{32} in bone and viscera of this patient, corroborates the observations made on the radioautograph. It may be observed that P^{32} accumulates selectively in the tumor as well as the newly formed bone which was being produced. The tissue assays of P^{32} showed both tumor and new bone to be

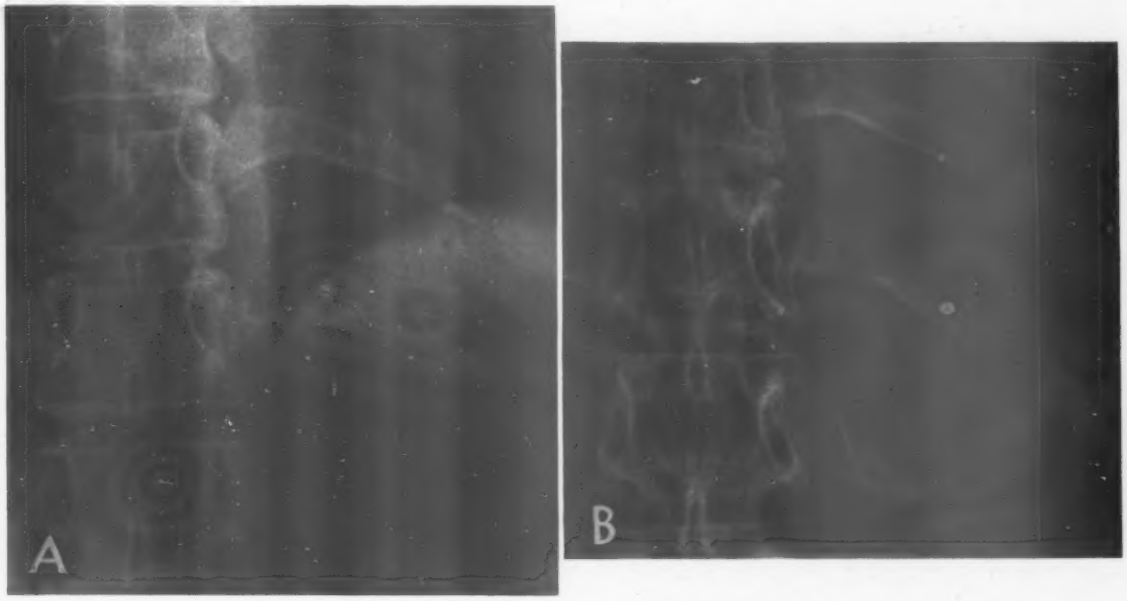

Fig. 8. (*A*) Roentgenogram of the left eleventh rib (Case VIII) made on October 7, 1948, immediately prior to treatment, shows osteolytic destruction having completely eroded the superior rib margin at the angle. (*B*) Roentgenogram of the left eleventh rib (Case VIII) made on February 7, 1949, approximately four months following therapy. There is marked recalcification of the rib with firm bony union.

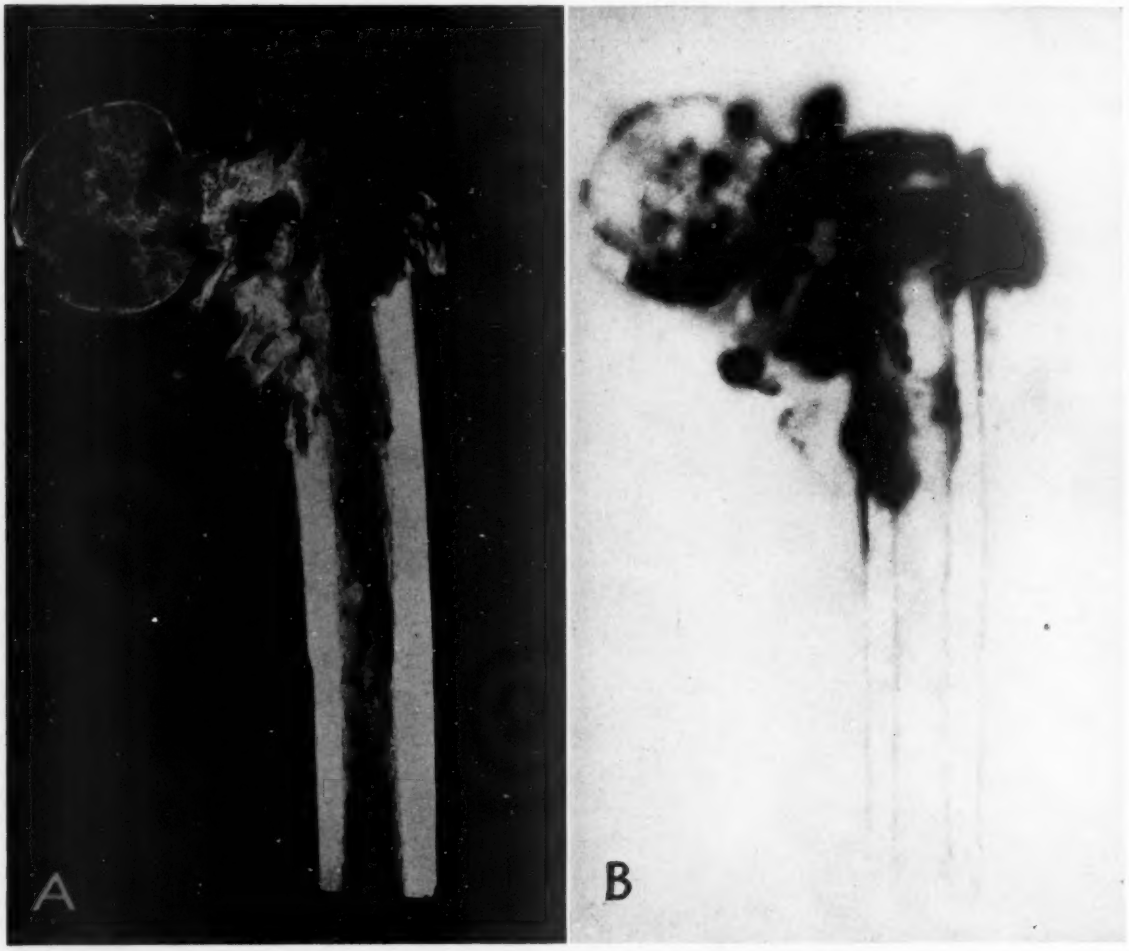

Fig. 9. (*A*) Roentgenogram of the thin bone slice of the left femur (Case x). There is extensive destruction and invasion by metastatic carcinoma. (*B*) Radioautograph of the bone section shown in (*A*). This indicates increased deposition of P^{32} in the region of the tumor invasion and the newly produced bone fragments which are present at the site of the pathological fracture. The dark areas represent the site of deposited P^{32}.

Table III

Relative uptake of P^{32} in various organs and tissues obtained at autopsy (case x)

Organ	Microcuries per Gram	Rank
1. Breast	0.0094	1.0
2. Adrenals	0.0244	2.6
3. Spleen	0.0376	4.0
4. Normal bone (femur shaft)	0.0442	4.7
5. Kidney	0.0448	4.76
6. Liver	0.0572	6.08
7. Metastasis in bone	0.0719	7.65
8. Metastasis in liver	0.1020	10.85
9. New bone at tumor site	0.2020	21.6

well above the levels found in the adult portion of the shaft.

Calculation of Radiation Dosage. An attempt is made to calculate the approximate radiation in equivalent roentgens which the bones may have received. This is difficult without certain major assumptions, but a general concept of the extent of the radiation may be obtained. The assumption is made that the biological half-life of P^{32} deposited in bone is 10.5 days (see Fig. 3). It is further assumed that one-third of the administered dose is lodged in bone and that bone represents 10 per cent

of body weight. On this basis, the calculations indicate that for 1 millicurie administered, the radiation produced in bone, integrated to complete decay, is about 30 rep, and for the average dose which was administered (3 mc. per 10 kilograms of body weight) this represents slightly over 600 rep. This calculation represents the approximate dosage for normal bone, and tumor tissue, which may have exceeded the bone level, received a greater radiation dosage directly dependent upon the increased uptake. In Case x, the osseous metastases appeared to receive about twice the dose delivered to normal bone. This would approximate 1,200 roentgen equivalents. The dosage as compared with roentgen rays does not appear to be large, yet would prove sufficient to retard tumor growth and accelerate recalcification.

SUMMARY

Studies presented here are essentially of a preliminary nature to determine whether P^{32}, administered to patients with widespread metastatic carcinomatosis of bone, would produce in some readily observable fashion amelioration of the terminal state of this disease. There is ample evidence in the literature, in studies on animals, and on observations made on our own cases, that selective absorption of P^{32} does occur in tumors. Since the selectivity in tumors is not great, large amounts of radiophosphorus are necessary. The dosage levels which were employed in these cases were high, and to extend these to still higher levels would appear to be a drastic and heroic form of treatment.

The most important complication of intensive P^{32} treatment is a severe depression of the hematopoietic system, and in the dosages used in these cases, sharp, and in some instances alarming depression of the blood elements occurred.

Of the twelve patients treated in this series, two patients showed objective improvement in the appearance of the osseous lesions as evidenced by recalcification on roentgen studies. There was definite relief from pain in all but two cases. Increase in longevity was not established, although it is difficult to escape from the encouraging response in the first patient who lived for six years.

It appears that patients who have widespread bone metastases from carcinoma of the breast may expect relief of pain, and occasional regeneration of invaded bone, in intensive treatment with radiophosphorus.

H. L. Friedell, M. D.
2065 Adelbert Road
Cleveland, Ohio

REFERENCES

1. Adair, F. E., Mellors, R. C., Farrow, J. H. Woodard, H. Q., Escher, G. C., and Urban, J. A. Use of estrogens and androgens in advanced mammary cancer. *J.A.M.A.*, 1949, *140*, 1193–1200.
2. Allen, J. G., Sanderson M., Milhauser, M., Kirschon, A., and Jacobson, L. O. Heparinemia (?). Anticoagulant in blood of dogs with hemorrhagic tendency after total body exposure to roentgen rays. *J. Exper. Med.*, 1948, *87*, 71–86.
3. Cohn, W. E., and Greenberg, D. M. Studies in mineral metabolism with aid of artificial radioactive isotopes; absorption, distribution, and excretion of phosphorus. *J. Biol. Chem.*, *123*, 185–198.
4. Council on Pharmacy and Chemistry. Report to the Council. Estrogens and androgens on mammary cancer. *J.A.M.A.*, 1949, *140*, 1214–1216,
5. Erf, L. A., Tuttle, L. W., and Lawrence, J. H. Clinical studies with aid of radio-phosphorus; retention in blood, excretion and therapeutic effect of radio-phosphorus on patients with leukemia. *Ann. Int. Med.*, 1941, *15*, 487–543.
6. Forssberg, A. Study of distribution of radioactive phosphorus in 3 cases of cancer. *Acta radiol.*, 1946, *27*, 88–92.
7. Forssberg, A. ,and Jacobsson, F. Studies on Brown-Pearce rabbit-carcinoma with aid of radioactive isotopes. *Acta radiol.*, 1945, *26*, 523–534.
8. Jones, H. B., Chaikoff, I. L., and Lawrence, J. H. Phosphorus metabolism of neoplastic tissues (mammary carcinoma, lymphoma, lymphosarcoma) as indicated by radioactive phosphorus. *Am. J. Cancer*, 1940, *40*, 243–250.
9. Kenney, J. M., Marinelli, L. D., and Woodard, H. Q. Tracer studies with radioactive phosphorus in malignant neoplastic disease. *Radiology*, 1941, *37*, 683–687.
10. Lawrence, J. H., and Scott, K. G. Comparative

metabolism of phosphorus in normal and lymphomatous animals. *Proc. Soc. Exper. Biol. & Med.*, 1939, *40*, 694–696.

11. Lawrence, J. H., Scott, K. G., and Tuttle, L. W. Studies on leukemia with aid of radioactive phosphorus. *Internat. Clin.*, 1939, *3*, 33–58.
12. Lawrence, J. H., Tuttle, L. W., Scott, K. G., and Connor, C. L. Studies on neoplasms with aid of radioactive phosphorus; total phosphorus metabolism of normal and leukemic mice. *J. Clin. Investigation*, 1940, *19*, 267–271.
13. Low-Beer, B. V. A., Lawrence, J. H., and Stone, R. S., Therapeutic use of artificially produced radioactive substances. *Radiology*, 1942, *39*, 573–597.
14. Marshak, A. Uptake of radioactive phosphorus by nuclei of liver and tumors. *Science*, 1940, *92*, 460–461.
15. Osgood, E. E., Aebersold, P. C., Erf, L. A., and Packham, E. A. Studies of effects of million volt roentgen rays, 200 kilovolt roentgen rays, radioactive phosphorus, and neutron rays by marrow culture technique. *Am. J. M. Sc.*, 1942, *204*, 372–381.
16. Tuttle, L. W., Erf, L. A., and Lawrence, J. H. Studies on neoplasms with aid of radioactive phosphorus; phosphorus metabolism of phospholipid, acid soluble and nucleoprotein fractions of various tissues of normal and leukemic mice following administration of "tracer" and "therapeutic" doses of radiophosphorus. *J. Clin. Investigation*, 1941, *20*, 577–581.

DISCUSSION

Dr. T. Leucutia, Detroit, Michigan. The paper presented by Drs. Friedell and Storaasli is of timely interest since it gives us a new approach in treating such a hopeless and greatly distressing condition as the widespread osseous dissemination from a primary carcinoma of the breast. Admittedly the material on which the study is based is limited and the time of observation was not extended over a period of two years, nevertheless certain fundamental facts have already been established. Foremost among these are: on the favorable side, the demonstration of the selective absorption of the P^{32} by the metastatic bone tumors so beautifully illustrated on the radioautograph and, on the unfavorable side, the depression of the hematopoietic system which sometimes assumes rather alarming proportions.

When used in conjunction with other more thoroughly tested methods, for instance deep roentgen therapy, colloidal lead therapy and hormonal therapy, the internal irradiation with radioactive phosphorus may open up certain new fields which are worthy of further exploration. To cite one example—during a study of the effect of colloidal lead orthophosphate used in association with deep roentgen therapy, a method which has been routinely practiced at Harper Hospital for many years, attempts were made to enhance the cancerocidal effect by "tagging" to the solution radioactive phosphorus. Preliminary tracer experiments on rabbits with solutions containing 0.1 millicurie of the phosphorus per 30 cc. of the colloidal lead orthophosphate solution ($Pb_3(Po_4)_2$) revealed data which are similar to those presented by the essayists here today. It is conceivable that by adding larger doses of radioactive phosphorus, extending into the range of therapeutic usefulness, the cancerocidal effect of the roentgen rays and lead could be substantially increased, leading to a definite improvement of the clinical results as compared to those obtained by either method alone. And there are other possible procedures.

In this sense the present preliminary reports of Drs. Friedell and Storaasli represent a very valuable contribution. It is hoped that they will continue their painstaking investigation by also pursuing new avenues of applicability of internal radioactive isotope therapy.

Dr. Robert S. Stone, San Francisco, California. Since Dr. Friedell was associated with me when he treated the first case, I feel that I ought to make some comment, and true to American tradition I wish to compliment Dr. Friedell on his excellent experimental work. Beyond that, I think I cannot go along with him, and my purpose in discussing his paper is to say so. I think Dr. Friedell will agree with me entirely that he is not advocating this as any method of therapy to be generally tried by anybody and that every one of you can tell your patients when they say, "Well, can't we use P^{32}?", that P^{32} has nothing to offer them that cannot be given by morphine to relieve the bone pain or by roentgen therapy or by nitrogen mustard or by one of the hormones or by one of the many other things which do not offer quite as much possibility of harm as P^{32}.

I think the philosophy behind treating patients with generalized bone metastases with the radioactive material that is taken up in such a small excess portion by the tumor is all wrong. I think it is nice to experiment with it, and somebody has to do it to find out what it will

do, but we certainly must consider it as an experiment and not as a method of therapy and we should certainly tell our patients that it is an experimental method of therapy, that we are trying to find out what it will do.

We have felt that we did not want to continue this type of treatment at the University of California because of the bad effects and I think most of us have produced results as good as those here reported by treating the ovaries with roentgen rays and finding lesions in the other part disappear or by direct roentgen therapy to bone metastases. Without detracting at all from the value of the experiment, I do wish that you would all remember that Dr. Friedell is reporting an experimental procedure and not advocating a method of treatment.

One other point I would like to make is that one of the reasons why this method doesn't work when new lesions are developing continuously is simply this: The P^{32} is taken up by the cells that are growing actively when it is administered. All cancer cells or normal cells are not actively growing at the same time. Some small deposits of cells that temporarily are inactive and that have not yet stimulated activity in the bone about them do not take up the P^{32}. When later they start to grow there is no circulating P^{32} for them to take up and, therefore, they go ahead and develop as they normally would. You would need to give the P^{32} continuously in order to catch the lesions that develop from time to time.

Dr. Friedell (closing). First of all, I want to thank the discussants for their very kind and pertinent comments. I think one question that was brought up has been answered in part by Dr. Stone. I feel that single large doses should theoretically be better in that you are immediately getting at the most active cells. On the other hand, all cells are not of equal activity and therefore one ought to stretch the exchange and distribution period over a reasonable interval so that any cyclic activity which may be present will be utilized to greatest advantage. I think deposition, and therefore localization, is dependent upon the activity of the cell together with its milieu.

Breast metastases in bone probably take up more phosphorus than ordinary soft tissue metastases because they are surrounded by tissue that has great affinity for phosphorus. The biological half-life for bone, which is an indication of the length of time that P^{32} is present in the bone, is about eleven days whereas in normal soft tissue it is about six or seven days. Thus the bone metastases have a longer time to exchange P^{32} than similar metastases elsewhere.

With regard to the comments of Dr. Stone, I think I must essentially agree with what he has said, that this is to be experimental in nature. It is not the sort of treatment that can be used promiscuously.

I have deliberately shown the severe hematopoietic depression that occurs in order to highlight the complications of treatment. I think it is interesting, however, that we were able to ameliorate the symptoms and actually regenerate bone at the site of some of these metastatic lesions. It may be true that you get exactly the same results with other forms of therapy. I think it important for the record, however, to know that it is possible with P^{32}.

With regard to the possible preference between P^{32} and roentgen therapy, it appears that roentgen therapy is superior if the metastatic lesions can be clearly localized, but I am certain that all of you have found that when one lesion can be clearly demonstrated, there are almost always numerous others that may not be visualized on roentgen examination or by other means. It is then a problem of whether the roentgen-ray beam should be directed only to the visualized lesions or to other areas that are known to be frequently involved by metastatic tumor. In such instances, radiophosphorus might be superior since, in a sense, it seeks out the lesion, thereby producing regression or destruction of the metastatic lesion even though its site may not have been clearly established.

We can make no special claims for the treatment of metastatic bone lesions with P^{32}. This is clearly borne out by the fact that 11 of the 12 patients are dead. I think, also, that it probably is not superior to other methods of treatment. The figures which we present, however, are quite comparable to what has been accomplished with hormone therapy.

I^{131} IN THE DIAGNOSIS AND TREATMENT OF HYPERTHYROIDISM*

By R. A. SHIPLEY, M.D., J. P. STORAASLI, M.D., H. L. FRIEDELL, M.D., PH.D., *and* A. M. POTTS, PH.D., M.D.

CLEVELAND, OHIO

THE avidity of thyroid tissue for iodide ion, although remarkably high in normal subjects, is substantially increased in cases of thyrotoxicosis. Through the use of tracer doses of radioiodine the high uptake and accelerated rate of accumulation which characterizes the overactive gland may be quantitated in a variety of ways. Such measurements have been applied by clinicians as an aid in the diagnosis of hyperthyroidism. The simplest procedures involve either a direct measure of the content of the isotope in the thyroid by a Geiger counter placed adjacent to the gland,[13,15,16] or an indirect calculation of uptake by assay of the urinary excretion.[2,6,7,9,10,12,15,16] The great bulk of radioiodine which fails to be excreted after forty-eight hours can be assumed to have been fixed in thyroid tissue. Other more complicated procedures include a determination of rate of uptake by means of frequent serial readings over the gland,[1] or an indirect measurement of thyroid accumulation rate by means of data obtained solely from urinary excretion,[7,9] or even a calculation of clearance of radioiodine from the blood by the simultaneous measurement of activity in the thyroid gland and blood.[8]

If radioiodine is to be widely used as a diagnostic aid, the method to be practical, must not require a complicated or lengthy procedure which will place an unusual burden and responsibility on the patient or the technical staff. In this respect, serial urine samples at short intervals are less desirable than is a single forty-eight hour collection.

In the present series of cases urine was routinely collected in two separate twenty-four hour portions. The original plan was to observe the effect of thyroid activity on the ratio of activity in these two samples. In general, there was a tendency for hyperthyroid patients to excrete a very high proportion of material during the first twenty-four hours and very little during the second, whereas in myxedema the second day's collection yielded a much more substantial fraction of the total. Normal cases were intermediate. A statistical study showed, however, that a calculation of this ratio did not give any better diagnostic selectivity than did the simple measurement of total forty-eight hour excretion.

The determination of thyroid collection rate, as reported by Keating and workers[7] involves the collection of six separate samples of urine over a seventy-two hour period. If the general formula of the excretion curve so obtained is valid, one should be able to employ the equation if only two points on the curve are known.* One shortcoming of such a practice is the magnification of error when two points are used instead of several. An even more important consideration is the question of the applicability of the formula of Keating to the interval between twenty-four and forty-eight hours. The results obtained when the

* The formula for the excretion curve is $Q = Q_f(1-e^{-rt})$ where Q is the cumulative per cent excretion at time t, Q_f the total amount in per cent ultimately excreted, and r the disappearance rate from the blood, which is equivalent to the slope of the curve obtained by plotting $Q_f - Q$ against time on semi-logarithmic paper.

The present data were treated as follows: The equation in terms of r is

$$r = \frac{1}{t \log e} \log \frac{Q_f}{Q_f - Q}.$$

Assuming r to be constant, and substituting the two known values for Q and t, at 24 and 48 hours, the following expression is obtained:

$$Q_f = \frac{(Q \text{ at } 24 \text{ hr.})^2}{2(Q \text{ at } 24 \text{ hr.}) - (Q \text{ at } 48 \text{ hr.})}.$$

The value of Q_f having been determined, r may easily be calculated, and collection rate $= r(1-Q_f)$.

* From the Departments of Medicine and Radiology, Western Reserve University School of Medicine and Lakeside Hospital, Cleveland, Ohio. Presented at the Fiftieth Annual Meeting, American Roentgen Ray Society, Cincinnati, Ohio, Oct. 4–7, 1949.

twenty-four and forty-eight hour urine values are substituted in this formula are presented below in some detail in order to illustrate why such a procedure is not applicable, and also to emphasize the tendency toward a different excretion pattern in normal and hyperthyroid subjects.

The second portion of the following report includes the results of therapy with I^{131} in a series of cases of thyrotoxicosis. Patients with diffuse goiter are considered separately from those with nodular goiter, and a comparison between the results in the two groups is made.

DIAGNOSTIC APPLICATION OF I^{131}

Methods. The solution of radioiodine was assayed in a Braestrup ionization chamber immediately after being received from Oak Ridge. This instrument accommodates a test tube containing a known volume of I^{131} solution to which has been added a stabilizing solution containing NaOH, $NaHSO_3$, and stable iodine carrier. A calibration curve for the chamber is first constructed by the use of a standard solution which has a known activity determined by absorption—extrapolation counting against a radium D+E standard. Unknown samples are then read in the chamber as r meter divisions per minute against microcuries of iodine I^{131}. In an intercomparison of assays of I^{131}, sponsored by the National Bureau of Standards in April, 1949, the value for the sample fell well within 5 per cent of the Bureau's value.

Urine assays were made on small evaporated samples to which had been added the stabilizing solution described above. By means of a direct beta count, a comparison was made with the original sample from which the tracer dose was given.

Direct readings over the thyroid were obtained by the use of an Eck Krebs type tube surrounded by a cylinder of lead $1\frac{1}{2}$ inches thick and perforated by a hole 1 inch in diameter in its side. The counting distance from the neck was 9 inches. This arrangement was considered to give a satisfactory geometry for a circle 6 inches in diameter over the region of the thyroid. At the time a count of the patient's thyroid was made, a solution of I^{131} equivalent to that administered to the patient, and contained in a 50 ml. volumetric flask, was counted at the same distance. The percentage uptake by the gland was calculated on the basis of the simple ratio of these two readings. Uptake measurements were made forty-eight hours after administration of the dose.

The isotope was given by mouth, usually two to three hours after breakfast and without iodide carrier in the great majority of cases. Tracer doses for normal subjects were 0.1 mc. or less; however, some of the patients with hyperthyroidism, who later were to receive therapeutic doses, received 0.25 or rarely 0.4 mc. No patients or euthyroid subjects had received either inorganic or organic iodine for therapeutic purposes during the preceding two weeks. Euthyroid controls were patients who had been admitted to the hospital for minor complaints unrelated to any thyroid disorder, and in none was there any indication of a metabolic disorder. No cases of hyperthyroidism were included if there was any doubt as to the diagnosis. In no case was the radioiodine study used as the basis for inclusion or exclusion of a patient.

Results. A summary of the diagnostic data is presented in Table 1. Although the values in the table are expressed in terms of excretion for the first forty-eight hours, it is convenient for purposes of discussion to interpret the results in terms of retention. The mean retention for the group of 15 normal subjects is thus 44.7 per cent with a range from 0 to 70. Since it is unlikely that a zero value could reasonably be expected in the presence of a normal gland, such a reading (which was encountered in only one case) probably reflects a technical error. The maximum retention for normal subjects is of the greatest importance for comparison with the group of hyperthyroid cases. There were 6 of the 46 patients with hyperthyroidism which retained less than the 70 per cent upper limit of the normal

TABLE I

COMPARISON OF FORTY-EIGHT HOUR OUTPUT WITH "COLLECTION RATE"

Diagnosis	No. of Cases	48 hr. Output per cent	Hyperthyroid Overlap with Normal	"t" Value	No. of Cases	Collection Rate per hr. per cent	Hyperthyroid Overlap with Normal	"t" Value
Hyperthyroid	46	16.8±2.1* (2.6–64.0)†	6 cases	6.8	42	6.5±0.41 (1.5–12.3)	22 cases	5.9
Euthyroid	15	55.3±5.2 (30–100)			14	2.7±0.49 (0.5–6.1)		
Myxedema	7	78 ±6.6 (51–100)	—	—	6	1.0 (0–1.8)	—	—

* St. E. of Mean.
† Range.

group. The range in the presence of hyperthyroidism was 97.4 to 36 per cent, and the mean retention of 83.2 per cent is quite significantly greater than that of normal subjects.

If the 16 cases of nodular goiter included in the total series are averaged separately, a mean retention of 81.4 per cent is obtained. The range remains at 97.4 to 36 per cent. Patients with diffuse goiter average 84.1 per cent with a range between 97 and 47 per cent. The difference between the two types of goiter is therefore slight.

Seven cases of myxedema are included in Table 1 for comparison with the other two groups. The overlap of forty-eight hours' retention in this group with the normal range is complete; however, the mean is considerably lower than normal.

Also included in Table 1 are the values for thyroid "collection rate" calculated from the urinary excretion at twenty-four and forty-eight hours. The value of 6.5 per cent per hour for the hyperthyroid group is distinctly greater than the 2.7 per cent for the controls. The rate for normal subjects is not greatly different from the 3.9 per cent reported by Keating's group; however, the rate for hyperthyroid cases is much lower than the 24.5 per cent obtained by Keating in exophthalmic goiter.[7,9] This discrepancy will be discussed later. A break-down of the series into diffuse and nodular goiters did not reveal any significant difference in the calculated "collection rate."

The difference between the mean "collection rates" of the two groups is highly significant; however, it is of particular interest that in 22 instances out of the group of 42 hyperthyroid patients, the values overlapped the upper limit encountered in euthyroid subjects (Fig. 1). This is considerably greater than the overlap for the total forty-eight hour excretion. The "*t*" value (Diff. of Means/St. E. of Diff.) is likewise inferior to that of the latter. It

TABLE II

UPTAKE BY URINE MEASUREMENT AS COMPARED TO DIRECT COUNT OVER GLAND

	Mean	Range	Method Giving Highest Value
48 hr. urine assay	81%±3.2*	36– 97%	24 cases
Direct count	69%±3.5*	30–100%	4 cases

* St. E. of mean.

may therefore be concluded that "collection rate" *as determined by the excretion values at twenty-four and forty-eight hours* is considerably less useful for the differentiation of hyperthyroid cases from normal than is the total retention by the gland as measured by forty-eight hour urinary excretion.

Uptake as measured by direct readings over the gland in 28 thyrotoxic subjects averaged 69 per cent as compared to 81 per cent for the indirect calculation by the method of urinary excretion (Table II). The over-all agreement is therefore very good. A 12 per cent mean deficit by direct reading is not surprising in view of the fact that a small amount of active material would be expected to remain in the body fluids and fail to reach either the urine or thyroid by the end of forty-eight hours. Two errors which might commonly occur are incomplete collection or urine and inaccurate centering of the counter tube over the gland. Both would tend to make the results by direct count apparently lower than by urine assay. One is therefore surprised not to find a greater discrepancy than the 12 per cent actually observed.

The widest difference between the two methods was in a case showing 92 per cent retention by urine assay and 53 per cent by direct measurement. There were only 4 instances where the direct reading gave the higher value. The respective values for excretion were 86, 83, 36, and 36 per cent, and the corresponding direct readings 100, 100, 57, and 42 per cent. Such discrepancies as the latter are difficult to explain and most certainly reflect technical errors. One hundred per cent retention in the gland, for example, is obviously impossible when 14 per cent has already been recovered from urine.

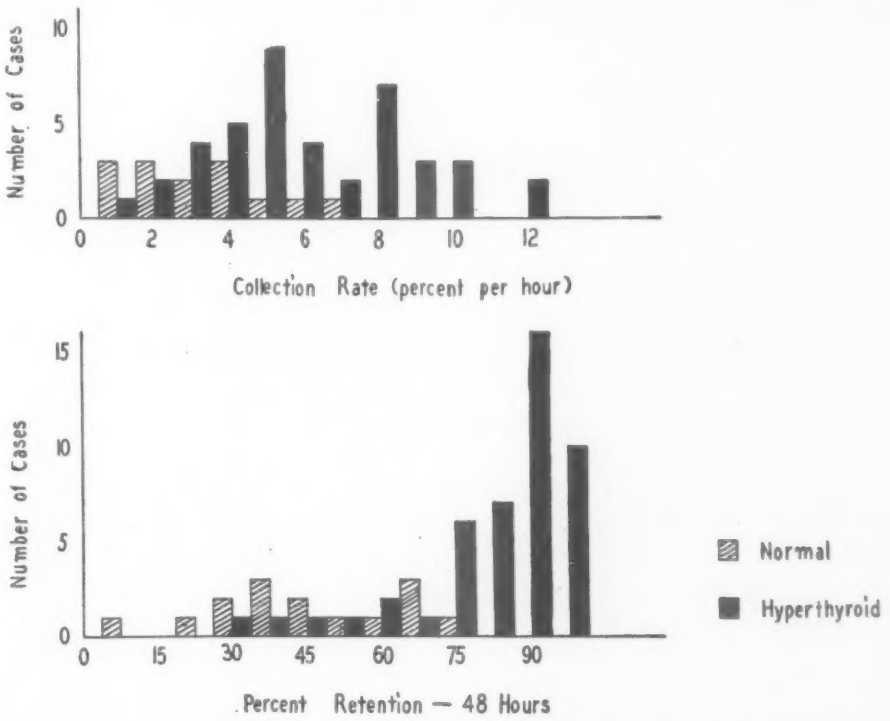

FIG. 1. The distribution of cases when compared on the basis of "collection rate" calculated as described in the text, along with that of forty-eight hour total retention.

DISCUSSION

The mean values for urinary excretion in thyrotoxic and euthyroid subjects are in reasonably good agreement with those of others (Table III). The degree of overlap

between the two groups varies from one laboratory to another. The fact that an overlap may occur means that radioiodine retention does not prove a specific diagnostic test for hyperthyroidism. In certain circumstances, however, it may be of considerable help when performed along with the usual clinical and laboratory procedures. It must be remembered that the tissue of variable size, is, however, theoretically not as good as might be desired. For the present, therefore, the plan has been adopted of employing both procedures whenever possible until such time as the technical details of the direct method have undergone further refinement.

One finding which merits rather extensive discussion is the relatively low value

TABLE III

PER CENT RADIODINE RETENTION AS REPORTED BY VARIOUS AUTHORS (MEAN AND RANGE)

Author	Urine			Direct Count		
	Euthyroid	Hyperthyroid		Euthyroid	Hyperthyroid	
		Diffuse	Nodular		Diffuse	Nodular
Hertz and Roberts*[6]		69(15–94)				
Chapman and Evans*[2]		66(14–91)				
Keating *et al.*[9]	36†	77†	56†			
McArthur *et al.*[10]	30(2–72)	75(55–93)				
Skanse and Riggs[12]	(16–47)	(68–94)				
Soley *et al.*[13]					61(12–92)	
Werner *et al.*[15,16]	48(24–72)	83(73–94)		21(11–36)	65(44–76)	52(33–67)
Present report	45(0–70)	84(47–97)	81(36–97)		69(30–100)‡	

* I^{130}
† Extrapolated "Renal Fraction"
‡ A few nodular goiters are included

secretory activity of the thyroid, while correlated with its iodine-storing activity, is an independent physiological function. Iodine uptake is markedly inhibited if the gland is already saturated by the previous administration of iodide, while an iodine-starved gland, on the other hand, behaves in the opposite manner. In that it is often difficult to evaluate the history of a patient in regard to his previous iodine intake, some of the overlap between normal and hyperthyroid subjects can probably be attributed to this unknown factor.

The observations on thyroid uptake, as determined by direct count, are not as yet extensive enough in our own hands to judge whether such a method is superior to that of urine assay. A direct reading has the decided advantage of relieving the patient of an important responsibility. The precision of an assay of radioactive material distributed in a relatively large mass of

for "collection rate" as determined by the excretion after intervals of twenty-four and forty-eight hours. Such an outcome may be, in fact, predicted from the published results of Keating and workers.[7] Their calculation of disappearance rate from the blood (r) was based upon a plot of at least six cumulative excretion values, which included several observations at short intervals *during the first twenty-four hours.* The value for the total amount ultimately excreted in the urine ($\mathcal{Q}_f$) would normally be represented by the asymptotic limit approached by such a curve. If, however, such a value for $\mathcal{Q}_f$ is used to determine "r" by a plot of $\mathcal{Q}_f - \mathcal{Q}$ against t on semilogarithmic paper, a straight line cannot be obtained in some instances unless the value of $\mathcal{Q}_f$ is artificially reduced. The above authors stated that such an occurrence was particularly common in cases of hyperthyroidism and they labeled this difference

between the experimental approximation of $\mathcal{Q}_f$ and the adjusted $\mathcal{Q}_f$ as "*a*." It should further be noted that when $\mathcal{Q}_f$ is thus reduced, the plot of $\mathcal{Q}_f - \mathcal{Q}$ is of necessity limited to the first portion of the curve, for $\mathcal{Q}_f - \mathcal{Q}$ becomes meaningless when $\mathcal{Q}$ exceeds $\mathcal{Q}_f$. This therefore means that the formula $\mathcal{Q} = \mathcal{Q}_f (1 - e^{-rt})$, is applied empirically only to the first portion of the curve in this instance, and that $\mathcal{Q}_f$ is not were obtained. An example of one of the cases is shown in Figure 2. The experimental value for $\mathcal{Q}_f$ was estimated at 24.4 per cent. The resulting curve has two components, an initial steep slope followed by a succeeding portion which is much flatter. It should be noted, however, that the second portion is definitely exponential and does not represent a linear phase in the late period of excretion as reported by Keating. The lower-

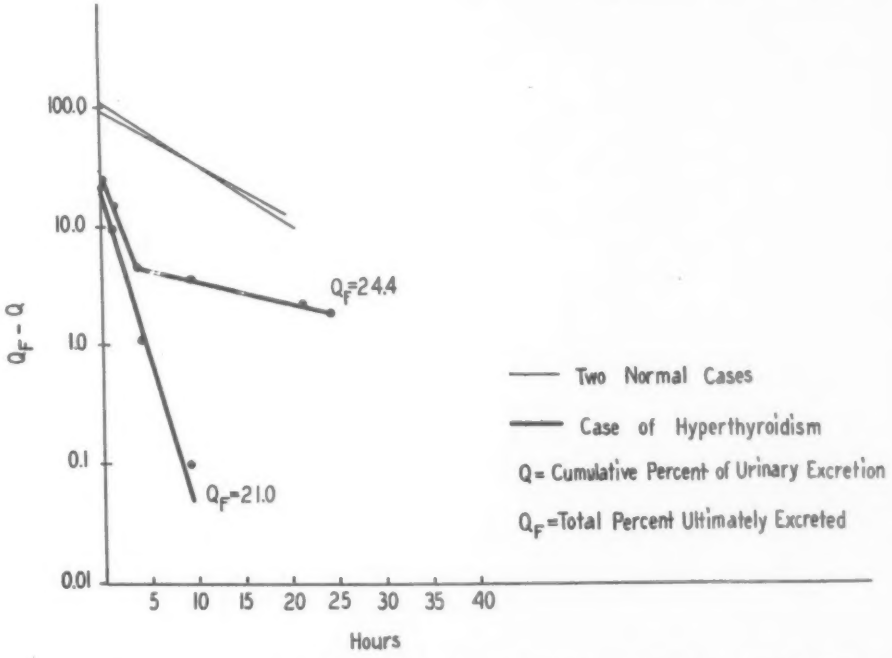

Fig. 2. Plot of proportional rate of urinary excretion. The slope is equivalent to that of disappearance rate from the blood. Four additional normal subjects not plotted, and 2 cases of myxedema gave simple straight lines when the observed $\mathcal{Q}_f$ was employed.

the actual ultimate renal fraction but an artificial value which allows the mathematical curve to fit the observed points during the first twelve to twenty-four hours, and also forces these values to fall upon a straight line when $\mathcal{Q}_f - \mathcal{Q}$ is plotted on semilogarithmic paper.

If the experimental rather than a mathematically adjusted value for $\mathcal{Q}_f$ is used in cases where the adjusted value would be lower, the plot of $\mathcal{Q}_f - \mathcal{Q}$ against time on semilogarithmic paper will not give a simple linear graph. In 2 cases of hyperthyroidism in which such a plot was made, two separate linear portions of different slope most curve in Figure 2 is that obtained when $\mathcal{Q}_f$ is adjusted to give a straight line for as many points as possible in the first portion of the curve. There is thus obtained a simple straight line with considerably steeper slope than the 2 normal cases at the top of the graph. Collection rate $(1 - \mathcal{Q}_f) \times r$ as determined from such a curve, will be considerably higher than if observations from the latter part of an excretion period are used with $\mathcal{Q}_f$ taken as a true asymptotic limit of a curve which is considered to be exponential also in this latter portion.

In a previous publication[11] it was likewise observed that the pattern of disappearance

of inorganic radioiodide from the blood consisted of a rapid early phase of decline, between two and eight hours, and a slower decline thereafter. It was pointed out that this suggested the existence of two concomitant exponential functions proceeding at different rates. Apparently the initial phase is the most selective for the differentiation of hyperthyroidism from the normal state. One should, therefore, be able to use the method of Keating most advantageously for the determination of "disappearance rate" and "collection rate" when the work was begun as they are at the present time, the earlier assays have been corrected to conform to the standardization as described earlier in the paper.

Dosage was estimated in terms of microcuries per gram of gland of retained I^{131}. Retention was predicted by measurement of the forty-eight hour urinary excretion of a tracer dose. Gland size was estimated by inspection and palpation. It was assumed that a normal gland weighs 20 grams and that the lowest limit of distinct diffuse enlargement represents a total weight of 35 gm. It was also assumed that 100 gm. is near the maximum weight usually reached by a diffuse gland. (Intermediate weights were estimated solely by judgment.) In nodular glands which exhibited prominent spherical nodules an attempt was made to refine the estimation of weight by a mathematical calculation of volume. A drawing, along with recorded measurements, was made of each gland for future reference while the patient was being followed.

Urinary excretion was re-determined after the therapeutic dose in order to verify that the uptake was as predicted. The amount excreted was usually very close to that obtained after the tracer dose.

The mean estimated thyroid weight in the presence of a diffuse gland was 58 gm., while for the nodular glands it was 73 gm. The mean dose of I^{131} administered, without correction for retention, was 7 mc. for patients with a diffuse goiter and 13.2 mc. for those with nodular goiter.

TABLE IV

SUMMARY OF THERAPEUTIC RESULTS (FIRST DOSE)*

	No. Cases	Mean Dose Retained and Range Microcuries per Gram	Sustained Control First Dose	No Response	Relapse	Gland Return to Normal Size	Temporary Hypothy.	Myxedema
Diffuse glands	29	95(53–140)	78%†	15%	7%	74%	7%	15%
Nodular glands	18	135(74–275)	83%	17%	0%	11%	0%	0%
Total series	47	110(53–275)	80%	16%	4%	49%	4%	9%

* Even though the groups are relatively small, percentages are used to facilitate comparison.
† Cases of hypothyroidism are included in this figure.

if only two or three urine samples are carefully collected during the first twelve to eighteen hours. Q_f would constitute an extrapolated value determined mathematically, and without necessarily being identical with the true total urinary excretion.

THERAPEUTIC APPLICATION OF I^{131}

Methods. Patients, for the most part, were not admitted to the hospital for treatment but were under close surveillance during the first several weeks after administration of the radioiodine. The doses which were used in some of the first patients of the series were roughly estimated by a calculation of the expected radiation to be delivered by a given dose of I^{131} as compared to that of doses of I^{130} which had previously been used.[2,6] The mean dose employed for the entire series turned out to be fairly close to this original approximation. Inasmuch as the methods of assay of I^{131} were not as well standardized

Results. Results of therapy are considered separately for diffuse and nodular glands (Table IV). There were 29 cases of the former and 18 of the latter. In the series composed of patients with diffuse enlargement, the mean dose, after correction for the portion lost by excretion, was 95 microcuries per gram, whereas in the presence of a nodular gland the average was 135 microcuries per gram. The disproportion in dosage between the two types of disease was an outgrowth of an early impression that nodular goiters were more resistant to over-treatment. Subsequent experience was in keeping with this impression. It may be seen from the table that the incidence of sustained remission after a single dose of material was approximately 80 per cent in each group. There were, however, 4 cases of myxedema (15 per cent) in those who had diffuse goiter, while such an outcome was not encountered in any of the patients with nodular goiter. Even temporary hypothyroidism was not observed in the latter series. Moreover, 74 per cent of glands that were diffusely enlarged regressed to normal size while only 11 per cent of the nodular variety did so. There were 2 instances of relapse in the former group and none in the latter, but this difference is too small to permit interpretation.

The first evidence of clinical improvement in both series was usually noted at about six weeks (Table V). A similar interval was required before there was a distinct shrinkage in the size of the gland. Maximal clinical improvement along with maximal regression of the goiter was most often attained at two and a half to three months, while a rare case required four to five months. Diffuse and nodular goiters did not differ significantly in their rapidity of response to therapy, although there was occasionally a slight delay in the latter type.

In 12 cases with various degrees of exophthalmos a reading of the eye prominence was made before, and three to four months after treatment. One case showed no change, most showed an increase of about 1.0 mm., and in one instance there was a decrease of 1.5 mm. The one patient, with no change at four months, later experienced an ultimate regression of 2.0 mm. after two years had elapsed. These eye changes are similar to the observations which have been made after thyroidectomy, wherein there is a tendency for a slight postoperative increase in exophthalmos.[14] One male patient, in the group having diffuse glands, suffered an acute and moderately severe opthalmopathy with puffiness of the lids, ocular discomfort, and chemosis at a three month interval after therapy.

There were 3 patients who experienced slight discomfort and local tenderness over the gland for three to five weeks after therapy. Only one instance of apparent aggravation of symptoms was encountered, and it is likely that emotional factors played a major role in this reaction.

Of the cases considered cured the great majority have been observed from six months to two and a half years after treatment. Two have been followed for only three months and their status is therefore somewhat tentative. In the following sections the cases with an unsatisfactory result are analyzed in more detail.

TABLE V

AVERAGE TIME SCHEDULE OF RESPONSE IN CASES CONTROLLED BY ONE DOSE (MEAN AND RANGE)

Type of Gland	First Measurable Decrease in Size	Maximum Decrease in Size	First Evidence of Decreased Hyperactivity	Complete Subsidence of Hyperactivity
Diffuse	1.4 mo. (½–2)	2.3 mo. (1½–3)	1.4 mo. (1½–2)	2.5 mo. (1½–4)
Nodular	1.4 mo. (1–3)	3.0 mo. (1½–5)	1.4 mo. (1½–3)	3.0 mo. (2 –5)

TABLE VI

CASES NOT CONTROLLED BY ONE DOSE

Case	Type of Gland	Weight of Gland	First Dose γc/gm.	Second Dose	Third Dose	Remarks
S.M.♀	Diffuse	65	88	—	—	No response whatever; failed to return
R.W.♀	Diffuse	80	75	81	140	Progressive decrease in gland size; clinical control not apparent till third dose
E.H.♂	Diffuse	50	87	87	—	No local or clinical response; thyroidectomy
R.B.♂	Diffuse	50	125	100	69	Second dose caused temporary remission; third dose, cure with mild hypothyroidism
M.A.♀	Nodular	60	118	—	—	No response whatever; thyroidectomy
M.M.♂	Nodular	75	77	51	127	Gland size unaffected; clinical cure after third dose
A.P.♀	Nodular	50	142	—	—	No response whatever; thyroidectomy

Failure to Respond: A summary of the cases which did not respond to a single dose is presented in Table VI. It may first be noted that the dosage was not greatly different from average. In the 3 patients where additional treatment was given on two succeeding occasions a clinical cure was ultimately realized. S. M., M. A., and A. P. failed to return for follow up and the latter 2 were operated on elsewhere because of dissatisfaction with results. S. M. remained completely unrelieved ten months after treatment but could not be induced to accept further treatment of any sort. E. H. was one of the early members of the series, and after two failures with radioiodine, he was advised to have a thyroidectomy. One of the 7 cases (R. W.) was considered severe, 2 were mild (E. H. and M. M.), and the rest were of average severity.

Relapse after Successful Control: The 2 cases which relapsed did so within one to two months after clinical signs of activity had disappeared (Table VII). The goiter was of a diffuse type in each instance. These patients differed from most of those with a diffuse gland in that a considerable amount of thyroid tissue was still palpable at the time that clinical control appeared to be complete. In V. M. a bilateral bruit persisted.

Transient Hypothyroidism: Two cases included in this category, which are shown in Table VIII, had no actual complaints suggestive of hypothyroidism. Even though the basal metabolic rate remained normal they are thus classified because of a distinctly elevated serum cholesterol which

TABLE VII

CASES WITH RELAPSE AFTER SUCCESSFUL CONTROL

Case	Type of Gland	Weight of Gland	First Dose γc/gm.	Time Required until Controlled	Interval between Time of Cure and Relapse	Remarks
J.P.♀	Diffuse	50	94	4 mo.	2 mo.	Second dose 117 γc/gm; sustained cure (10 mo.).
V.M.♀	Diffuse	80	95	3 mo.	1 mo.	To be given 90 γc/gm. on basis of 60 gm. gland

TABLE VIII

TRANSIENT HYPOTHYROIDISM

Case	Type of Gland	Weight of Gland	First Dose	Second Dose	Time after Final Dose Signs Were Apparent	Nature of Evidence
J.P.*♀	Diffuse	50→40	94	117	3 to 4 mo.	Cholesterol 350, subsequently normal, BMR never below normal
E.J.♂	Diffuse	75	141	—	3 to 5 mo.	Cholesterol 378; subsequently normal, BMR never below normal

* Same patient as first case in Table VII.

became evident shortly after clinical remission was complete. In the succeeding several months the cholesterol returned to normal and no subsequent evidence of hypothyroidism appeared.

Myxedema: The 4 cases of myxedema (Table IX) are of particular interest because they might be considered the most serious kind of poor result which was encountered. As has been previously stated, the goiter was in every instance diffuse in character, and except in S. J., on whom a previous thyroidectomy had been performed, the gland was perfectly symmetrical and relatively soft. Patients J. B. and C. H. had received no previous treatment while W. P. had been given Lugol's solution for the control of his disease until two months before receiving radioiodine. All cases may be classified as moderate as far as severity of the disease is concerned. One striking fact was that all were males. It may be noted in this connection that half of the patients having diffuse goiters were males, while only 3 of those with nodular goiters were of this sex.

The first evidence of hypothyroidism was a rise in serum cholesterol to levels of 400 to 600 mg. per 100 cc. at about two months after treatment. Shortly thereafter puffiness of the face, dry skin, sluggishness and muscle pains appeared in all instances, except in S. J. The metabolic rate did not fall below minus 20 per cent until three or more months had elapsed.

These patients have been followed for ten months to two and a half years. In cases W. P. and S. J. withdrawal of thyroid one year after therapy led promptly to a return of clinical and laboratory evidence of myxedema. C. H. has been followed after being given thyroid for only ten months. J. B. did not show a frank return of myxedema when thyroid was stopped after one year of therapy, although his basal metabolic rate remained at minus 17 per cent.

DISCUSSION

One of the findings most worthy of comment is the relative tolerance of nodular goiters to comparatively high doses of

TABLE IX

MYXEDEMA

Case	Type of Gland	Weight of Gland	Dose γc/gm.	Time Gland Became Impalpable	Time Symptoms Appeared	Time High Cholesterol Noted	Time BMR to Fall Below −20
W.P.♂	Diffuse	75	80	6 wk.	3 mo.	2 mo.	>3 mo.
J.B.♂	Diffuse	60	122	2 mo.	3 mo.	—	3 mo.
C.H.♂	Diffuse	50	87	2 mo.	3½ mo.	2 mo.	<7 mo.
S.J.♂	Diffuse	60	53	3 mo.	No symptoms	<4 mo.	<4 mo.

radioiodine. Myxedema appears to be less of a hazard, and shrinkage of thyroid tissues is less complete than in patients with diffuse glands. The other striking observation was the occurrence of myxedema in cases of diffuse goiter when the apparent retained dose was near or below the over-all average, yet higher doses than average in certain patients were completely ineffectual, or were followed by relapse. If the occurrence of myxedema were attributable to overestimation of correct dosage, one cannot place the blame on an incomplete collection of urine because such an error would lead to a falsely high estimate of retention, and thereby reduce the calculated dose. Overestimation of gland size is a distinct possibility, however, this could not have been a systematic error in the series as a whole, because the incidence of myxedema was matched by an approximately equal fraction of cases which failed to respond.

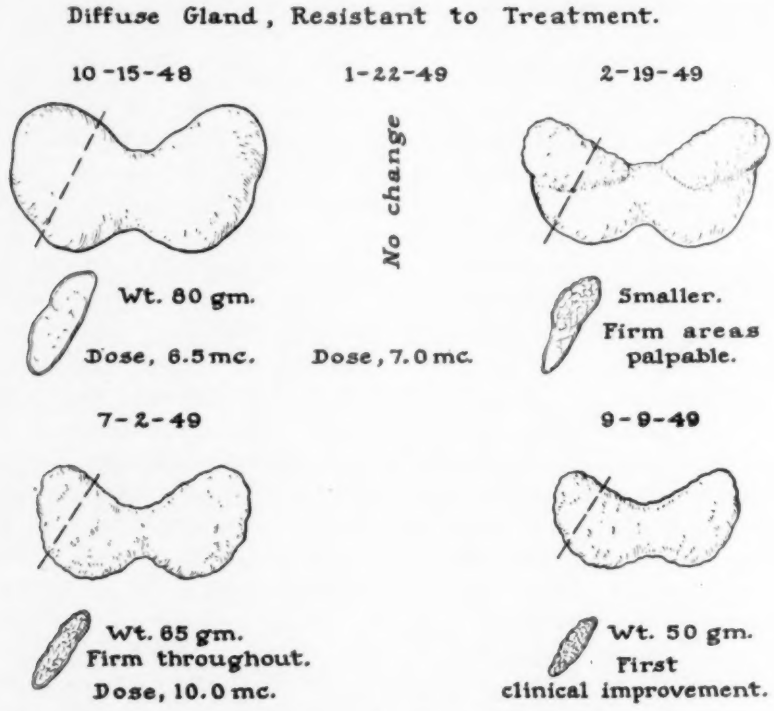

FIG. 3. A clearly demarcated, firm area became evident in each lobe of the gland. This portion shrank less rapidly than the remainder of the gland. Other cases were observed wherein a diffuse but asymmetrically enlarged gland ended with one or two small nodular areas which failed to disappear.

An attractive explanation of the unpredictability of response, which in fact has already been suggested,[9] is that goiters which are considered diffuse may not always take up radioiodine in a perfectly uniform manner, but rather in a patchy distribution. If such happened to be the case in a given gland, the regions experiencing low uptake would be difficult to destroy by radiation from I^{131} and complete ablation of thyroid tissue would be unlikely. If, on the other hand, follicles which accepted iodine were distributed in a highly diffuse fashion, complete destruction of all thyroid tissue could be attained with ease. The resistance of nodular glands to complete destruction is an extreme example of unequal distribution of functioning tissue. It has been shown that different nodules in the same gland are highly variable in their affinity for iodine.[9] In our own experience, radioautographs of nodular glands have shown extreme variability even from one follicle to another within a given nodule.

A number of patients with apparently diffuse glands have shown unequal shrinkage of hyperplastic tissue in various parts of the gland (Fig. 3). Some have ended up with small nodular remnants on one side or the other. Such reactions of the gland constitute further evidence in favor of the concept that the distribution of isotope in the gland has not been as diffuse as one might anticipate.

Table X

SUMMARY OF THERAPEUTIC RESULTS WITH I^{131} (SINGLE DOSE)

Author	Type of Gland	Dose (Mean and Range) per gm. of Thyroid (microcuries)	Dose per Patient mc.	Controlled	Uncontrolled	Temporary Hypothy.	Myxedema
Haines *et al.*[5]	Diffuse	240(65–574)	–(2.6–20.0)	68%	32%	—	17%
Soley *et al.*[13]	Diffuse	78(21–248)	3.1(–)	91%	9%	—	4%
Werner *et al.*[15]	Diffuse	100(50–250)	–(3–4)	68%	32%	10%	0%
Present series	Diffuse	95(53–140)	7.0(2.8–11.4)	78%	15%	11%	15%
	Nodular	135(74–275)	13.2(3.9–40.0)	83%	17%	0%	0%

If one compares the mean dosages which have been reported by others in the therapy of hyperthyroidism with diffuse goiter, a fairly wide spread is apparent (Table x), and it is difficult to correlate clinical results with the dose (per gram of thyroid) which has been given. The expectancy of control with a single dose ranges between 69 per cent and 91 per cent, while the mean dose varies from 78 to 240 microcuries per gram. It is of interest, however, that the series which corresponds to a mean dose of 78 microcuries is the one which showed 91 per cent control, while the one with 240 microcuries had a mean control rate of only 68 per cent. Such discrepancies might be attributable to lack of uniformity of assay of I^{131} in various parts of the country. It could also be due to chance variations in the equality of histological distribution of isotope within certain glands, or to variations in the estimate of gland size. The crude mean dose per patient as given in Table x would not be influenced by the latter error, and is therefore of considerable interest. It ranges from 3.1 mc. to probably 10 mc. When dosage is considered in this manner the frequency of myxedema is better correlated with the amount of material given, and it appears, moreover, that when lower dose ranges are employed the incidence of poor control does not increase to an extent comparable to the decline in incidence of myxedema.

Any comparison of results obtained when I^{131} is given in divided portions, as contrasted with the effect of a single dose, is not possible. The former method has been followed in certain clinics.[3,17] A total of several small doses is not the biological equivalent of a single large dose. There is no doubt that all cases may be controlled if there is sufficient repetition of treatment. Such a scheme, nevertheless, is frowned upon by many patients because of the long interval required for final cures. Moreover, it has not been established that myxedema is less frequently encountered when such a regimen is followed.

The time has not yet arrived to make unqualified claims as to the therapeutic status of I^{131}. It would hardly be disputed that a patient in whom the operative risk is high, and in whom there is intolerance to antithyroid drugs is an excellent candidate for such therapy. As far as more widespread

application of the treatment to ordinary cases is concerned, it seems clear that there is no danger of immediate mortality, and that even the possible minor side effects are very infrequent. The advantages over surgery also include freedom from such complications as hypoparathyroidism or the severance of the recurrent nerve. Moreover, hospitalization of the patient is usually not required. The incidence of myxedema in most reported series of cases is one complication which at present is seen more frequently than after thyroidectomy. The over-all incidence of postoperative myxedema, probably ranges between 2 per cent and 9 per cent when the goiter is of a diffuse type.[4,18] It is of interest that with surgical treatment, as with radioiodine therapy, this complication is more frequent in diffuse goiters.

The possibility of late carcinogenic effects from I^{131} has been repeatedly mentioned. There is no evidence that such an outcome may be sufficiently frequent to prove serious; however, the danger cannot be clearly ruled out until present patients are followed for many years.

SUMMARY

1. The mean retention of radioiodine in euthyroid subjects, as measured by urinary excretion, averaged 45 per cent. The mean retention in the presence of thyrotoxicosis was 83 per cent. Considerable overlap occurred between normal and thyrotoxic subjects. In a subgroup of patients with toxic goiter, the retention by direct count averaged 69 per cent as compared to 81 per cent when determined by urinary assay.

2. Thyroid "collection rate," as determined by Keating *et al.*, does not give a satisfactory differentiation of normal and thyrotoxic cases when it is calculated on the basis of two twenty-four hour urine samples collected during the first forty-eight hours. Adequate values for "collection rate" could undoubtedly be obtained if two or three separate collections were made during the first twelve to twenty-four hours.

3. In a series of twenty-nine diffuse goiters treated with a mean dose of 95 microcuries of I^{131} per gram of thyroid, 78 per cent were controlled, 15 per cent failed to respond to a single dose, and 7 per cent relapsed. Myxedema occurred in 15 per cent. The gland usually returned to normal size.

4. Of a group of eighteen cases of nodular goiter treated with a mean dose of 135 microcuries per gram, 83 per cent were controlled, 17 per cent failed to respond, and there were no cases of relapse or of myxedema. The gland usually did not return to normal size.

5. It was not possible to relate the occurrence of poor response or of myxedema with the size of dose given, the severity of the disease, or the size of the gland. It is believed that variations in response may be largely due to differences in homogeneity of uptake among various follicles of the gland.

H. L. Friedell, M. D.
2065 Adelbert Road
Cleveland, Ohio

REFERENCES

1. Astwood, E. B., and Stanley, M. M. Use of radioactive iodine in study of thyroid function in man. *West. J. Surg.*, 1947, *55*, 625–639.
2. Chapman, E. M., and Evans, R. D. Treatment of hyperthyroidism with radioactive iodine. *J.A.M.A.*, 1946, *131*, 86–91.
3. Crile, G. McCullagh, E. P., and Glasser, O. Radioiodine in treatment of hyperthyroidism. *Cleveland Clin. Quart.*, 1949, *16*, 1.
4. Goldman, L. Experiences with thyroidectomy in thyroid clinic. *J. Clin. Endocrinol.*, 1948, *8*, 781–788.
5. Haines, S. F., Keating, F. R., Power, M. H., Williams, M. M. D., and Kelsey, M. P. Use of radioiodine in treatment of exophthalmic goiter. *J. Clin. Endocrinol.*, 1948, *8*, 813.
6. Hertz, S., and Roberts, A. Radioactive iodine in study of thyroid physiology; use of radioactive iodine therapy in hyperthyroidism. *J.A.M.A.*, 1946, *131*, 81–86.
7. Keating, F. R., Jr., Power, M. H., Berkson, J., and Haines, S. F. Urinary excretion of radioiodine in various thyroid states. *J. Clin. Investigation*, 1947, *26*, 1138–1151.
8. Keating, F. R., Wang, J. C., Luellen, T. J., Williams, M. M. D., Power, M. H., and McConahey, W. M. Measurement of iodine-accumulating function of human thyroid

gland. *J. Clin. Investigation*, 1949, *28*, 217.
9. KELSEY, M. P., HAINES, S. F., and KEATING, F. R. Radioiodine in study and treatment of thyroid disease. *J. Clin. Endocrinol.*, 1949, *9*, 171.
10. MCARTHUR, JANET W., RAWSON, R. W. FLUHARTY, R. G., and MEANS, J. H. Urinary excretion of radioactive iodine as aid in diagnosis of hyperthyroidism. *Ann. Int. Med.*, 1948, *29*, 229.
11. POTTS, A. M., SHIPLEY, R. A., STORAASLI, J. P., and FRIEDELL, H. L. Effect of thyroid secretory activity on distribution of radioiodine in plasma. *J. Lab. & Clin. Med.* To be published.
12. SKANSE, B. N., and RIGGS, D. S. Thyrotoxicosis factitia (alimentary thyrotoxicosis): its differentiation from spontaneous thyrotoxicosis with aid of radioactive iodine. *J. Clin. Endocrinol.*, 1948, *8*, 532.
13. SOLEY, M. H., MILLER, E. R., and FOREMAN, N. Graves disease; treatment with radioiodine (I^{131}). *J. Clin. Endocrinol.*, 1949, *9*, 29.
14. SOLEY, M. H. Exophthalmos in patients with various types of goiter. *Arch. Med. Int.*, 1942, *70*, 206–220.
15. WERNER, S. C., QUIMBY, EDITH H., and SCHMIDT, C. Clinical use of radioactive iodine. *Bull. New York Acad. Med.*, 1948, *24*, 549.
16. WERNER, S. C., QUIMBY, EDITH H., and SCHMIDT, C. Use of tracer doses of radioactive iodine, I^{131}, in study of normal and disordered thyroid function in man. *J. Clin. Endocrinol.*, 1949, *9*, 342.
17. WILLIAMS, R. H., JAFFE, H., ROGERS, W. F., TOWERY, B. T., and TAGNON, R. Reciprocal relationship of radiotherapeusis and thyroid function. *J. Clin. Investigation*, 1948, *27*, 562.
18. WILSON, W. D., and MAYO, C. E. Postoperative myxedema. *Surgery*, 1940, *7*, 117–121.

DISCUSSION

DR. U. V. PORTMANN, Cleveland, Ohio. The authors have presented a very meticulous study on the use of I^{131} in the treatment of hyperthyroidism. I am sorry that I did not have time to analyze our series of cases on the same basis that they have used. I received their paper the day before I came to Cincinnati.

The patients that we see are first seen in the Department of Internal Medicine or Surgery and given a complete examination. Those with evidence of hyperthyroidism are referred to the Department of Radiology, if I^{131} is to be used either as a tracer dose or for treatment. Usually patients with evidence of hyperthyroidism are given a tracer dose first, probably a day or two before treatment. The dosages are calibrated and given according to the estimated size of the gland. In our clinic patients with diffuse goiters have been treated with approximately 4 millicuries. After the administration of either the tracer or the treatment dose, the uptake is measured with a Geiger counter.

During the past year, we have given I^{131} to 385 patients. Of these, 124 have received only tracer doses for diagnostic purposes, often for diseases not related to toxic goiter, such as subacute thyroiditis, to find out the effects if any.

Two hundred and sixty-one patients were treated and, of these, 5 had malignant disease but only 1 was benefited. This leaves 256 patients treated for hyperthyroidism either with diffuse or nodular goiters. Of these, 155, or 60 per cent, had remissions with one treatment. Sixty-seven, or 25 per cent, had two treatments. Three or four treatments were given to 12.5 per cent; practically all of these patients had large nodular goiters.

As the authors indicate, the diffuse goiters responded much more favorably and quickly than the nodular goiters. Our experience in regard to the correlation of clinical response according to the size of the dose, severity of disease or the reduction in the size of the thyroid and the appearance of myxedema conforms with that of the authors. The occurrence of myxedema is about the same following administration of I^{131} as after thyroidectomy. These patients respond favorably to the administration of thyroid.

VITAMIN D RESISTANT RICKETS (REFRACTORY RICKETS)*

By JOHN F. HOLT, M.D.
ANN ARBOR, MICHIGAN

VITAMIN D resistant rickets, or refractory rickets, as it is more commonly called, is an apparently rare metabolic disorder of childhood which differs from ordinary infantile rickets in that spectacularly large doses of vitamin D (50,000, to 1,000,000 units per day) are required to effect a cure and to prevent recurrences. The disease was recognized as an important clinical entity by McCune[3,5] in 1935 when concentrated preparations of vitamin D first became available. Because these same concentrates subsequently have reduced florid infantile rickets to the vanishing point in the United States, the refractory variety has assumed increasingly greater importance. Undoubtedly many examples of the disease remain unrecognized, and it is largely for this reason that the present report is submitted. As far as we have been able to determine, no articles dealing with refractory rickets have previously appeared in the roentgenologic literature.

The blood chemistry in patients with refractory rickets is almost identical to that found in infantile rickets, viz. normal serum calcium, low serum phosphorus and elevated serum phosphatase. One difference lies in the fact that the serum phosphorus level remains persistently low despite intensive treatment. Furthermore, decreased urinary calcium excretion is not as prominent a feature as it is in ordinary rickets. There is increased fecal excretion of calcium and phosphate which Albright *et al.*[1,2] have shown to be due to decreased absorption of these substances from the intestinal tract. Why this aberration in intestinal absorption occurs in the presence of what would ordinarily be ample amounts of vitamin D is the great unknown factor in refractory rickets. The relatively frequent occurrence of the disease in several members of a family indicates that the peculiarity is a hereditary one.

In a typical case of unrecognized refractory rickets, the onset occurs early in the post-infantile period and persists into later childhood. A roentgenologic diagnosis of rickets is made but may be retracted when it is learned that the patient has had adequate vitamin D intake and when conventional treatment fails to effect a cure. Rickets of renal origin is considered but is ruled out when blood chemistry determinations are found to be incompatible, and when studies of the urinary tract are persistently negative. Profound skeletal deformities develop, the patient appears dwarfed and a diagnosis of chondrodystrophy is made. Corrective osteotomies are done but these are to no avail because, with the rachitic process still active, the deformities invariably recur. The disease may stop at puberty but more often it persists into adult life as osteomalacia (adult rickets).

Roentgenologically, refractory rickets has much the same appearance as other types of rickets. One sees generalized rarefaction and coarsening of the trabecular pattern of various bones, irregular fraying of the epiphyseal plates, widening of the spaces between the epiphyseal ossification centers and the shafts, and cupping of the ends of the shafts. Secondary deformities such as bowleg, coxa vara, knock-knee and saber shin are more common and more profound in refractory rickets than in infantile rickets, as are greenstick fractures, pseudofractures and angular deformities of the upper extremities. In the refractory variety, one is apt to observe rachitic

* From the Department of Roentgenology, University of Michigan, Ann Arbor, Michigan.

changes in unusual locations such as the angles of the scapulae, the elbows and the ischiopubic synchondroses. The humeri may appear short and broad as in chondrodystrophy and the thoracic cage is more apt to be deformed. The lamina dura around the teeth is almost invariably absent or poorly defined.

Although the roentgenologist cannot make a definitive diagnosis of refractory rickets, he should suspect it in any patient past the age of two years who has roentgenologic signs of active rickets and who has no evidence of renal, liver, pancreatic or intestinal disease. The great importance of keeping the diagnosis of refractory rickets in mind and giving a therapeutic test of vitamin D in large doses to those patients in whom it is suspected lies in the fact that apparently all patients with the disease can be cured if large enough doses of the vitamin are prescribed.[4]

It appears that patients with refractory rickets can safely tolerate much larger quantities of vitamin D than normal individuals, but this tolerance varies, and the dividing line between adequate control of the rickets and the development of vitamin D intoxication may be extremely fine. Hence, close supervision during therapy is imperative. Preferably, this should be done by a pediatrician thoroughly familiar with the intricacies of metabolic bone disease.

The following case reports represent a brief review of our experiences with refractory rickets at the University of Michigan. We have been particularly conscious of this remarkable disease since 1944 when the findings in 2 siblings (Cases I and II) misdiagnosed by us as examples of atypical chondrodystrophy were reviewed by McCune and Caffey* and properly categorized. Since that time we have had the opportunity to correct similar misdiagnosed cases and have studied several additional patients of our own.

* Donovan J. McCune, M.D., and John Caffey, M.D., College of Physicians and Surgeons, Columbia University, New York, N. Y.

REPORT OF CASES

Case I. J. P. (516004), female, white, aged four and one-half, was seen briefly at University Hospital in 1942 because of inability to walk. Birth weight was 10 pounds and this increased on breast feeding which was continued for seven months. Orange juice and cod liver oil were given irregularly. The child's teeth first erupted at eight months, she sat erect at five months and walked for a short while at eight months. Shortly thereafter, her mother observed that the child's feet began to turn out and her joints became hypermobile. A physician prescribed what were described as large doses of calcium and vitamin D, this therapy being continued until the age of two years when the patient began to walk again. She continued to walk for a few months but the apparent deformity of the legs on ambulation was discouraging to the parents and the patient was not allowed to walk again. Medication also was discontinued.

Physical examination showed slightly prominent parietal bosses, scoliosis, flaring of the costal margins and apparent thickening of the anterior rib ends. The clavicles were unusually prominent, the abdomen was protuberant, the wrists and ankles were hypermobile and there was pronounced bilateral genu valgum deformity. The clinical diagnosis was Morquio's disease, and a roentgenologic survey of the entire skeleton was requested.

Roentgenograms of the tubular bones showed "coarsening of the trabecular pattern in the metaphyseal regions, soft tissue swellings in the regions of the various epiphyses and deep transverse bands of increased density in the metaphyseal zones" (Fig. 1). Absence of the lamina dura around the teeth was observed in retrospect.

Unduly influenced by the clinical findings, the roentgenologist agreed with the clinical diagnosis of Morquio's disease, but stated that "the possibility of rickets and particularly renal rickets should be kept in mind since some of the roentgen findings are suggestive of this disease."

Unfortunately the patient was in the hospital for only one day, and she failed to return at a later date. She died in October, 1943, of pneumonia.

Case II. H. P. (538818), the fifteen month old brother of J. P. (Case I), was brought to University Hospital on December 20, 1943, because he could not use his legs. The child's

mother stated that he seemed quite well until the age when he should have walked. At this time it was observed that the patient could not stand, sit or turn over voluntarily. The family physician had made a diagnosis of "an obscure muscle disease" and had recommended hospital study.

Birth history and dietary history were non-contributory. Both orange juice and cod liver oil had been given regularly since breast feeding was stopped when the infant was one month old.

Physical examination revealed a well developed child who weighed 24 pounds. Frontal and parietal cranial bosses were prominent, the four teeth which had erupted were widely spaced, the hands and wrists were thick and broad, and the various joints seemed somewhat hypermobile. Although the child did not move his lower extremities, the reflexes were quite active—a finding which seemed to rule out primary muscle disturbances such as a myotoma congenita. Blood serum calcium was 9.0 mg. per 100 cc.; serum phosphorus 3.8 mg. per 100 cc.; serum alkaline phosphatase 17 King-Armstrong units.

It was thought that the child had the same disease as his sister and a roentgenologic skeletal survey was obtained.

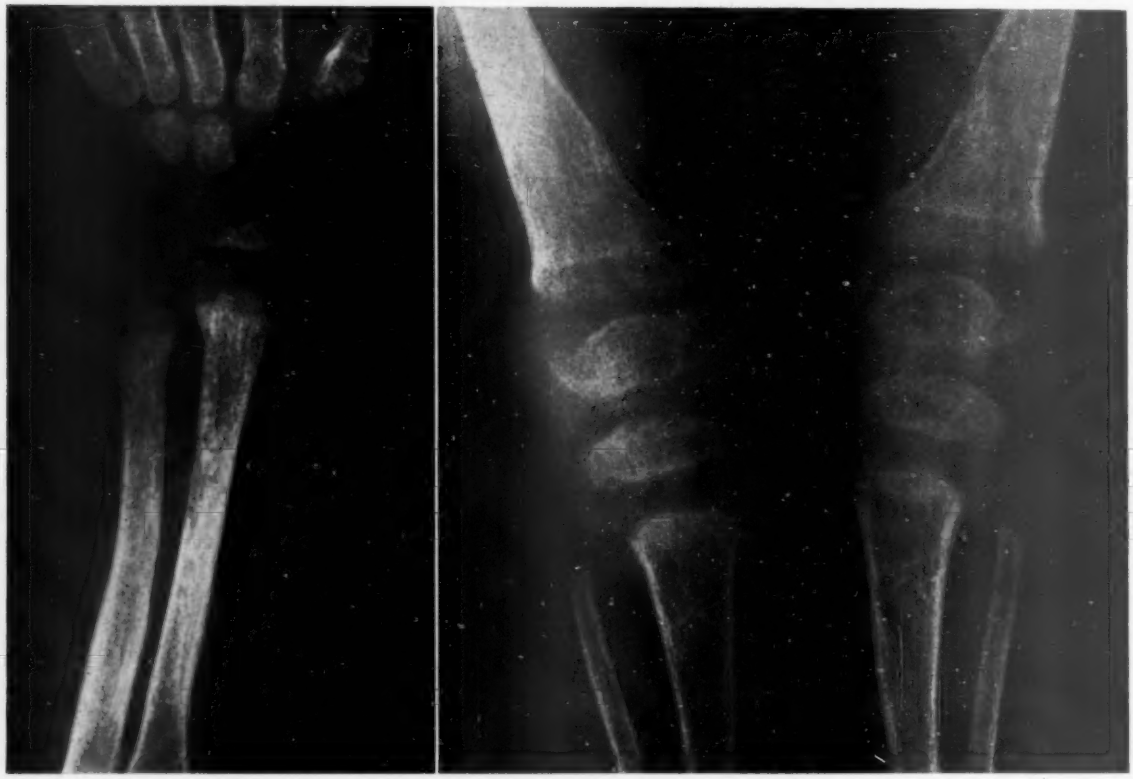

Fig. 1. Case 1. J. P., four and one-half year old girl with profound rachitic changes which progressed despite adequate diet and supplemental vitamin D. There is coarsening of trabecular pattern, fraying of ends of metaphyses, extreme broadening of rachitic intermediary zones and swelling of epiphyses. Note delay in carpal ossification, localized rounded zones of rarefaction in distal femoral metaphyses and incomplete tubulation of these metaphyses.

Roentgenograms on December 20, 1943, showed generalized decalcification of the entire skeleton. The outstanding changes were seen in the endochondral portions of the long bones where there were broad zones of diminished density between the epiphyses and the metaphyses, as well as irregular fraying of the metaphyseal ends (Fig. 2). The trabecular pattern of all bones was "coarsened," lamellated periosteal new bone formation was present on the medial aspect of each tibia, radius and ulna, and partially healed fractures were seen in the mid-portion of each fibula. In the skull there

Fig. 2. Case II. H. P., fifteen month old brother of J. P., with similar clinical findings. There is unusually pronounced rickets which persisted despite what was thought to be adequate vitamin D intake. Rachitic changes at elbow are unusually prominent. Moderate degree of periosteal cloaking indicates partial healing.

were prominent frontal and parietal bosses, dentition was somewhat delayed and the lamina dura was not present around the tooth sockets (Fig. 3).

The roentgenologist commented further that "the most interesting feature about this patient is the apparent incongruity between roentgenographic findings which are absolutely typical of rickets, and the clinical findings and blood chemistry which certainly are not indicative of vitamin deficiency disease. Furthermore there is nothing in clinical or laboratory findings which would suggest endogenous rickets. In view of these facts, one can merely point out that there is some very definite abnormality in the transformation of cartilage into normal bone, the exact cause of which is indeterminate." "In view of the generalized osteoporosis, coarsening of trabecular pattern and the presence of fibular fractures bilaterally, the possibility of some defect in osteoblastic activity such as is seen in osteogenesis imperfecta comes to mind, but the obvious and most spectacular changes in the ends of the long bones are certainly not in keeping with the classical form of this entity."

The final roentgenologic impression was "Characteristic roentgen signs of severe rickets, not confirmed by clinical and laboratory findings."

Re-examination of the skeletal system on May 29, 1944, showed no significant change

Fig. 3. Case II. Lateral view of jaw showing absence of lamina dura around the tooth sockets.

except for healing of the fibular fractures. On this occasion the roentgenologist's report read in part as follows:

"The etiology of the pronounced alteration in this patient's skeletal system remains obscure. The changes are still more characteristic of rickets than anything else from a purely objective point of view, yet there is even less reason to suspect such a diagnosis than there was previously because for the past

Fig. 4. Case III. M. B., five year old girl with severe bowing of lower extremities due to refractory rickets.

five months the patient has been on large doses of vitamin D. It is well known that certain types of osteochondrodystrophy may be confused with rickets insofar as roentgen signs are concerned, and in view of clinical findings, the diagnosis of osteochondrodystrophy seems likely. Atypical hyperparathyroidism and osteogenesis imperfecta are other possibilities to be considered."

The patient was discharged as an example of unclassified osteochondrodystrophy.

Comment. These siblings emphatically illustrate the difficulties in diagnosis which may arise when one is unaware of the particular disease entity under discussion. Furthermore, although clinical signs in any disease cannot justifiably be minimized, apparent incompatibilities between clinical and roentgenologic findings should not always be resolved in favor of the former.

As to the specific roentgenologic findings in these 2 patients, particular mention should be made of the so-called rachitic intermediary zones which are spectacularly wide. Attention is also directed to the small rounded zones of diminished density in the diaphysis and proximal metaphyses which resemble the small islands of cartilage seen in certain types of chondrodystrophy. The absence of the lamina dura around the tooth sockets is especially well shown in both patients. This sign, which may also be found in hyperparathyroidism, seems to be a rather consistent finding in refractory rickets.[2]

Rickets at the distal ends of the humeri is rarely manifested roentgenologically. The fact that this was a prominent finding in both sister and brother indicates the profound nature of the rachitic involvement.

Case III. M. B. (505309), a five year old white girl, was first seen at University Hospital in 1942 for treatment of bowlegs which had been present since one and a half years of age, and which had been getting progressively worse despite ordinary prophylactic vitamin therapy. Physical examination showed dwarfism, severe genu varium, flaring and beading of the ribs and Harrison's groove. Routine blood and urine examination showed no abnormal findings. Serum calcium determination was 10.3 mg. per 100 cc.; serum phosphorus 2.4 mg. per 100 cc. (low for growing child); serum alkaline phosphatase 13.9 units.

Roentgenograms of the lower extremities taken on June 4, 1942 (Fig. 4), showed profound bowing of both tibias and femurs. Irregularity and fraying of the metaphyses with widening of the spaces between the metaphyses and the epiphyses were observed. There also was moderate flaring and cupping of the metaphyses. The findings were considered to be typical of rickets.

The child had no symptoms or signs referable

to the intestinal tract and no renal disorder was found. Thus when the patient did not respond to the supposedly "large" dose of 5,200 units of vitamin D daily, it was eventually decided that she did not have rickets at all, but instead had some form of atypical chondrodystrophy. As a result, the patient had corrective osteotomies of the tibias and femurs in 1942 and 1943 respectively. The immediate result was quite satisfactory, but within a year the deformities had recurred, and then proceeded to become progressively worse. Anterior bowing of the tibias also developed, the deformity of the right tibia being accentuated by a true fracture and a pseudofracture which appeared on the anterior aspect of the bone (Fig. 11).

A definite diagnosis of refractory rickets was made in 1947 when the patient was referred from the Bone and Joint Department back to the Pediatrics Department for re-evaluation. Carefully controlled metabolic studies revealed the patient to be in negative calcium and phosphorus balance which was promptly corrected when she was placed on 100,000 units of vitamin D daily. After two weeks on this high dosage, the child was retaining 1.1 grams of calcium and 0.43 gram of phosphorus daily. Serum calcium was 9.8 mg. per 100 cc.; serum phosphorus 3.4 mg. per 100 cc., serum alkaline phosphatase 3.1 King-Armstrong units.

It was found that 50,000 units, then 100,000 units of vitamin D daily were insufficient to heal the patient's rickets, and in April, 1948, she was placed on 500,000 units per day, and watched carefully for signs of vitamin D intoxication. During the ensuing seventeen months the patient's rickets healed completely only to recur when the dosage of vitamin D was moderately reduced because the patient developed signs of hypervitaminosis D. When the vitamin D intake was again increased, the rickets responded once more (Fig. 5).

Fig. 5. Case III. M. B. (*A*) (April 1, 1948) Active rickets. Patient taking 500,000 units of vitamin D daily. (*B*) (November 5, 1948) Rickets completely healed. However, patient was vomiting, her urine showed strongly positive Sulkowitch reaction (hypercalcuria) and blood serum calcium had reached dangerous level of 16.7 mg. She was thought to have hypervitaminosis D, and dosage was reduced to 100,000 units daily for two months and 150,000 units daily for five months. (*C*) (June 17, 1949) Recurrent rickets despite large doses of vitamin D. Dosage raised to 300,000 units daily. (*D*) (September 7, 1949) Partial healing of rickets.

Comment. This patient also illustrates the initial problem in differential diagnosis when one is not aware of refractory rickets as an entity. Despite the initial unqualified roentgenologic impression of rickets, such a diagnosis was eventually considered untenable by all concerned and ill fated corrective osteotomies were done.

The inherent dangers of massive doses

of vitamin D likewise are emphasized. The dividing zone between adequate control of refractory rickets and the development of hypervitaminosis D may be extremely narrow and for this reason, extreme caution must be exercised during the course of treatment. Daily testing of the urine for hypercalcinuria with Sulkowitch's reagent is a simple yet effective method of detecting impending vitamin D intoxication.

Although we are apt to regard alterations in blood chemistry, especially serum phosphorus determination, as being the most sensitive indicator of the activity of a rachitic process, it should be emphasized that the serum phosphorus in a case of refractory rickets usually remains low despite intensive treatment. Hence, it behooves one to rely more heavily upon roentgenologic examination in following the course of this disease. The great value of roentgenologic signs as an index of rachitic activity is graphically illustrated by Figure 5.

Case iv. C. B. (654283), a four year old white girl, was first seen at University Hospital in February, 1949, with a history of bowlegs and waddling gait since she began to walk at ten months of age. The patient had been given oleum percomorphum irregularly during her first two years and had spent her entire third winter in Florida where she also received 25,000 units of drisdol daily by mouth. Physical examination showed apparent dwarfism, severe bowleg deformity and pronounced lumbar lordosis. Routine urine and blood examinations were negative. Serum calcium was 10.9 mg. per 100 cc.; serum phosphorus 2.5 mg. per 100 cc.; serum alkaline phosphatase 19.2 King-Armstrong units and total serum proteins 8.16 gm. Blood urea nitrogen was 13.5 mg. and a urine concentration test in fourteen hours showed a specific gravity of 1.030. Metabolic balance studies were similar to those cited in the previous case.

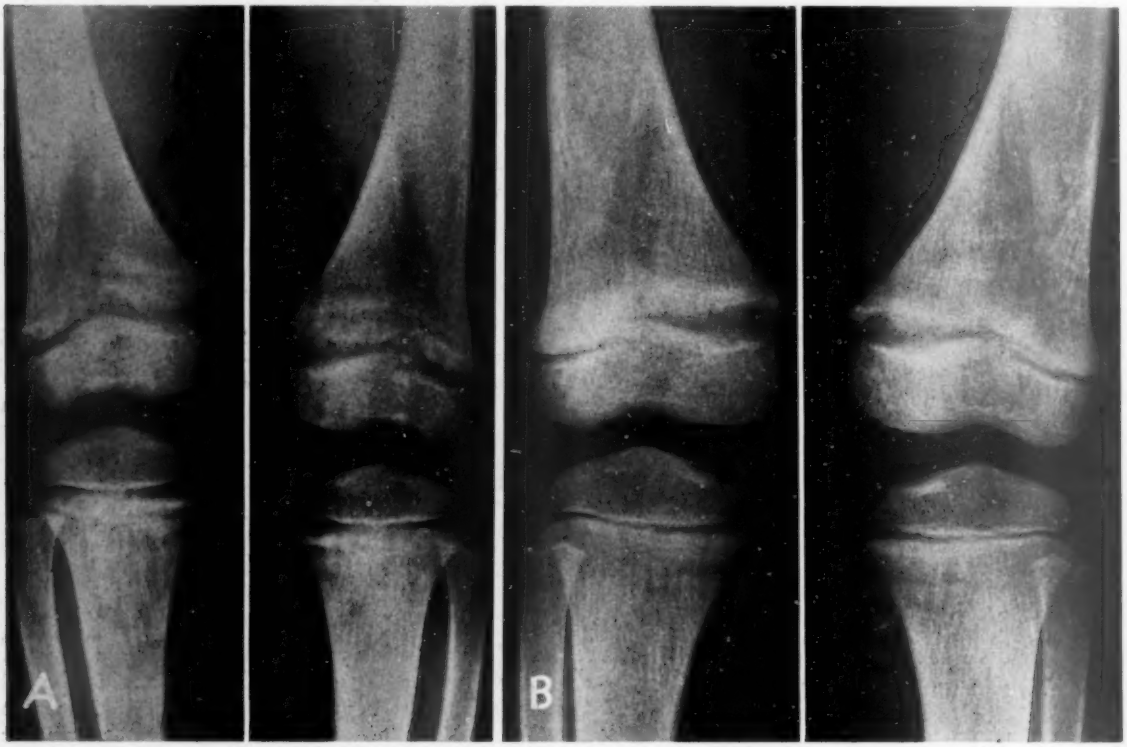

Fig. 6. Case iv. C. B., four year old girl with refractory rickets. (*A*) (February 25, 1949) Typical appearance of active rickets at knees. (*B*) (September 1, 1949) Partial repair following large doses of vitamin D. Roentgenograms of wrists showed complete healing.

Fig. 7. Case IV. Relative shortening, broadening and angulation of humerus suggestive of chondrodystrophy.

Roentgenograms of the tubular bones on February 25, 1949, showed generalized rarefaction, coarsening of the trabecular pattern, bowing, flaring, cupping and irregular fraying of the metaphyses typical of active rickets (Fig. 6*A*). Rachitic changes were also seen at the angles of the scapulae and there was moderate flaring of the anterior rib ends. Other findings of special interest were the relatively short, broad appearance of the humeri (Fig. 7) and the angulation of the radii such as one sees in chondrodystrophy.

Correlated findings (clinical, roentgenologic, laboratory) were considered diagnostic of refractory rickets although several clinicians commented on an unmistakable resemblance in the patient's habitus to that seen in chondrodystrophic dwarfism.

Vitamin D was prescribed as follows: (February 25 to March 24, 1949, 15,000 units daily), (March 24 to May 28, 1949, 50,000 units daily), (May 28 to September 1, 1949, 150,000 units

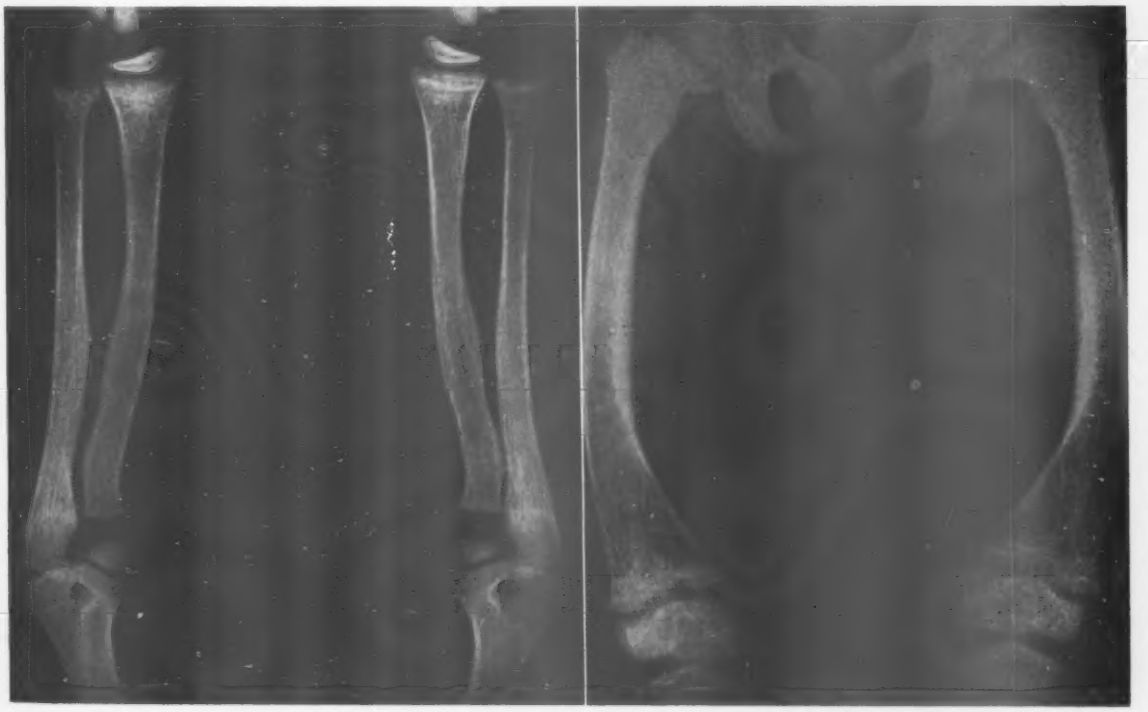

Fig. 8. Case V. I. D. Advanced rachitic changes in three year old girl erroneously diagnosed clinically as Morquio's disease. Coarsened metaphyseal trabecular pattern is particularly pronounced.

daily). Check-up roentgenograms of the wrists on September 1, 1949, indicated that healing was virtually complete, but those of the knees and ankles showed only partial repair (Fig. 6*B*).

Additional roentgenograms on December 15, 1949, showed still further healing of the rickets and striking decrease in the extent of bowing of the lower extremities.

Comment. Despite the misleading history and general chondrodystrophic appearance of this patient, the diagnosis of refractory rickets was made promptly and accurately due to the fact that on this occasion both pediatricians and roentgenologists were keenly aware of the disease as a significant entity.

Fig. 9. Case v. Patient (left) with sister one and one-half years younger. Dwarfism, prominent sternum, pot belly and deformed legs are especially noteworthy. Tibias have been straightened temporarily by osteotomies.

Case v. I. D. (209934), a three year old white girl initially observed at University Hospital in 1929 for treatment of severe bowleg deformity which the patient's mother had first noticed at the age of fourteen months when the patient began to walk. Cod liver oil was not given until the age of eleven months at which time a diagnosis of rickets had been made. Despite what was thought to have been more than adequate amounts of cod liver oil and a nutritious diet, the bowing had become progressively worse.

Physical examination and roentgenograms of the long bones (Fig. 8) confirmed the diagnosis of active rickets but when the child failed to respond to further antirachitic measures, the diagnosis was regarded by some with justifiable skepticism. As a result, the patient began a long, unfortunate course of treatment by braces, plaster casts and osteotomies for correction of deformities of the legs which persistently recurred. Numerous determinations showed the blood serum calcium to be normal, serum phosphorus to be persistently low. Metabolic studies indicated that the patient was in negative calcium balance (during one fourteen day metabolic control period in 1933, total calcium input was 13.51 gm. whereas total calcium output was 24.5 gm.). No convincing evidence of renal or intestinal disease could be found at any time.

The patient was followed periodically over a period of thirteen years at which time she was discharged as an example of atypical chondrodystrophy, probably Morquio's disease.

Comment. In retrospect, it seems most likely that this patient had refractory rickets. Roentgenologic findings are absolutely typical of rickets and the diagnosis is further substantiated by blood chemistry determinations and calcium balance studies. Failure of the child to respond to normally adequate vitamin D intake in the absence of detectable renal, hepatic or intestinal disease more or less confirms this impression. Unfortunately, the patient never received the huge doses of vitamin D which very likely would have effected a cure and clinched the diagnosis.

The dwarfism in refractory rickets, so pronounced in this patient (Fig. 9), prompts one to consider the mechanism by

which this lack of normal skeletal growth is brought about in a disease supposedly confined to calcium metabolism. One wonders if there is not some other factor in the metamorphosis of cartilage into bone in long-standing rickets which imparts to the disease more than a superficial resemblance to chondrodystrophy.

Albright[2] believes the lack of skeletal growth can be explained solely on the basis of disordered calcium metabolism, and presents a plausible hypothesis to support his views. He states that the sequence of events might possibly be "(1) relative unsaturation of body fluids with calcium phosphate, (2) failure of calcification of the zone of provisional calcification of cartilage, (3) failure of mature calcium cells to die, (4) failure of blood vessels to break into the holes left by dead cartilage cells, (5) continuation of proliferation of cartilage cells, (6) an increasing distance between proliferating cartilage cells and blood supply, and (7) failure of cartilage cells to proliferate due to lack of blood supply."

Case vi. W. W. (297861), a two year old white boy, was first seen at University Hospital in 1932 because of "crooked legs." Birth weight was 7½ lb. Eruption of teeth began at six months, patient sat erect at eight months, talked at eighteen months and walked at nineteen months. The infant was breast fed for ten months, received orange juice regularly from three months on, but was not started on cod liver oil until the age of twenty months. Bowing of the legs was first observed when the child began to walk.

Physical examination showed prominent frontal and parietal bosses, flaring of the costal margins, slight beading of the ribs, protuberance of the abdomen and very marked bowing of the legs. The clinical diagnosis was rickets.

Routine examination of the blood and urine showed no abnormality. Roentgenograms initially were interpreted as showing evidence of healed rickets, but, in retrospect, signs of activity can be seen in all films.

The patient was followed periodically over a period of thirteen years during which time his leg deformities were treated by various orthopedic procedures including several osteotomies. Much speculation concerning the child's failure to respond to a consistently high caloric and "high" vitamin diet led to eventual agreement among the orthopedists and pediatricians attending him that the initial diagnosis of rickets was in error and that the child had some peculiar form of dyschondroplasia.

In 1937 the patient was hospitalized for further study because "it was thought that this was an unusual type of rickets which possibly might be caused by some endocrine disturbance." On this admission, serum calcium was 8.6 mg. per 100 cc., and on repetition was 9.7 mg. per 100 cc.; serum phosphorus was 2.8 mg. and 2.7 mg. per 100 cc.; basal metabolic rate was plus 7 per cent; blood cholesterol was 216 mg. per 100 cc.; blood nonprotein nitrogen was 30.4 mg. per 100 cc., and urea clearance in specimen one was 111 per cent, in specimen two 67 per cent.

Roentgenograms of the skull were regarded as normal but in retrospect one can see absence of the lamina dura around the tooth sockets. On this and several other occasions, films of the chest and spine showed considerable deformity of the thoracic cage with features suggesting chondrodystrophy. Furthermore, a flat exostosis on the lateral aspect of the upper third of each humerus was observed.

In 1938 it was noted that the patient's mother had essentially the same type of deformities as her son, and this fact was considered as confirmatory evidence that the boy's condition was a hereditary growth disturbance, probably atypical chondrodystrophy.

Between 1938 and 1944, the patient was treated at another hospital. The left femur was surgically straightened in 1942, but by January, 1944, anterolateral bowing had recurred.

Corrective osteotomies of the left tibia and fibula were done at University Hospital on January 29, 1944, and on August 2, 1944, the patient fell, fracturing his left tibia through the site of a previous osteotomy. At the time of the patient's last visit on July 18, 1945, this fracture had healed completely but there was considerable residual anterior bowing (Fig. 10).

Comment. Here again, in retrospect, we must regard this patient as an example of refractory rickets that is of particular interest because of the thirteen year follow-up. On each of the thirty-one times that the patient was examined roentgenographi-

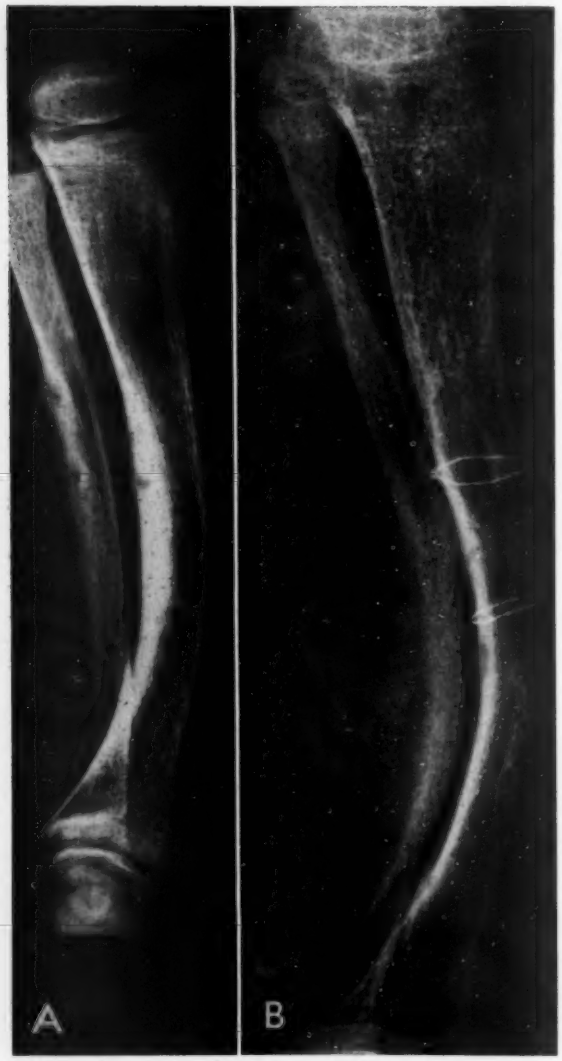

Fig. 10. Case vi. W. W., a two year old boy with probable refractory rickets. (*A*) (August 6, 1937) Signs of active rickets still present five years after initial visit to hospital. There are pseudofractures on posterior aspects of the tibia and fibula. (*B*) (July 18, 1945) Increased degree of anterior bowing of left tibia and fibula despite corrective osteotomy. Rickets still active thirteen years after first hospital admittance.

cally at this hospital, a roentgenologic diagnosis of rickets was submitted, but because clinical and laboratory findings were thought to be incompatible, the final clinical diagnosis was atypical chondrodystrophy. Many of the roentgenographic findings in the patient as well as his mother suggest chondrodystrophy, but the signs of rickets are incontrovertible. Although it is entirely possible for a chondrodystrophic individual to have superimposed rickets, the long series of films available seem to indicate conclusively that, in this case at least, the rickets came first and that chondrodystrophic changes occurred secondary to interference with the blood supply to growing cartilage incident to protracted severe rickets (see discussion of Case v).

DIFFERENTIAL DIAGNOSIS

There are several diseases from which vitamin D refractory rickets must be differentiated. Except in the case of late rickets, the differential diagnosis can usually be made on the basis of roentgen findings alone.

Chondrodystrophy. The difficulties encountered here have already been emphasized in the various case summaries included in this report. Although numerous differential points could be enumerated, in brief the absence of true rachitic changes at the epiphyseal-metaphyseal junctions and normal blood chemistry determinations should suffice to identify an atypical chondrodystrophy.

Osteogenesis Imperfecta. During the period of rapid growth of the tubular bones, no difficulties should arise in the differential diagnosis of rickets and osteogenesis imperfecta. After closure of the epiphyses, however, mild forms of osteogenesis imperfecta with generalized osseous rarefaction, flaring of the metaphyses and extensive deformities due to bone softening and multiple fractures may closely simulate the roentgen findings in long-standing refractory rickets (Fig. 11). Patients with relatively mild forms of osteogenesis imperfecta tend to have especially blue sclerae and their blood serum phosphorus levels are normal.

Hyperparathyroidism. Primary hyperparathyroidism apparently is extremely rare in infants and children. Those instances in which it occurs during adolescence, and in which there are pseudorachitic changes

in the metaphyses can be differentiated from true rickets on the basic of elevated blood serum calcium, hypercalcinuria, hyperphosphaturia and the presence of areas of cystic rarefaction in the long bones.

Renal Rickets. According to Albright, the bone changes in this condition resulting from chronic renal insufficiency are actually due to secondary hyperparathyroidism. This concept is difficult for roentgenologists to accept at face value because, although rare instances of so-called renal rickets show roentgenologic osseous changes which are virtually indistinguishable from those of primary hyperparathyroidism, the majority of cases have typical roentgen signs of rickets with few if any of the stigmata of hyperparathyroidism.

Be that as it may, so-called renal rickets is the most important entity for one to bear in mind in the differential diagnosis of refractory rickets. Both are discovered most frequently in childhood rather than in infancy, both are associated with dwarfism and both may produce identical roentgenologic signs, The differential diagnosis depends upon various renal function tests and blood chemistry determinations. In renal rickets the serum phosphorus level is high, whereas in refractory rickets it is persistently low.

The differentiation of these two conditions is extremely important because in refractory rickets there is so much to offer the patient from the standpoint of therapy.

de Toni-Fanconi Syndrome. This rare form of late rickets supposedly due to degenerative changes in the renal tubular epithelium is similar to refractory rickets in that both are characterized by an hereditary tendency and hypophosphatemia. In the Fanconi syndrome, however, there is renal glycosuria and hyperaminoaciduria, features not found in refractory rickets.

Late Privational Rickets. Infantile rickets due to dietary deficiency without any endogenous factor at work can persist into later childhood, but it is extremely uncommon past the age of two years in the United States. Furthermore, it will respond to very small doses of vitamin D.

Fig. 11. Striking similarity in appearance of tibia and fibula of patient (*A*) with refractory rickets and patient (*B*) with osteogenesis imperfecta. Patient (*A*) (Case III, this report) has a pseudofracture in the mid-tibia and also a true fracture just distal to the pseudofracture. Patient (*B*) with osteogenesis imperfecta shows a partially healed fracture in mid-tibia.

Other Forms of Rickets. In certain types of pancreatic, hepatic or intestinal insufficiency and in congenital biliary atresia. rachitic changes may occur in varying degrees of severity. Biliary atresia manifests itself in early infancy and as such is no problem in the differential diagnosis of refractory rickets. We have had no experience with the other types mentioned.

SUMMARY

Refractory rickets is a peculiar, apparently hereditary form of late rickets not associated with recognizable visceral disease, and characterized by dwarfism,

severe deformities, persistent hypophosphatemia and good therapeutic response to very large doses of vitamin D.

Roentgenologists should be thoroughly familiar with refractory rickets because, in a given case, it is usually on the basis of unequivocal roentgenographic signs that rickets is first considered as the diagnosis. The physician who is unaware of a refractory form of the disease is apt to disregard the roentgenologic diagnosis of rickets in the face of a history of apparently adequate vitamin D intake or failure of the patient to respond to moderately large doses of the vitamin. By the same token, the unwary roentgenologist may alter his initial diagnosis of rickets in the face of this seemingly overwhelming clinical evidence against it. Consequently, the patient may be subjected to ill-fated surgical procedures for correction of bowing and other deformities at a time when his rachitic process is still active.

Once the diagnosis of refractory rickets is established and the patient is started on the tremendous doses of vitamin D necessary to effect a cure, careful supervision of the therapy is essential to prevent the development of vitamin D intoxication.

University Hospital
Ann Arbor, Mich.

REFERENCES

1. Albright, F., Butler, A. M., and Bloomberg, E. Rickets resistant to vitamin D therapy. *Am. J. Dis. Child.*, 1937, *54*, 529–547.
2. Albright, F., and Reifenstein, E. C. The Parathyroid Glands and Metabolic Bone Disease. Williams and Wilkins Company, Baltimore, 1948.
3. McCune, D. J. Refractory rickets. Conference, Region I, American Academy of Pediatrics, October 19, 1934. *J. Pediat.*, 1935, *6*, 872–873.
4. McCune, D. J. Refractory rickets. *Am. J. Dis. Child.*, 1949, *77*, 112–113.
5. McCune, D. J. Personal communication.

Vol. 64, No. 4

DUODENAL ULCERS SIMULATING PREPYLORIC LESIONS

By ALICE ETTINGER, M.D.

Roentgenologist-in-Chief, Joseph H. Pratt Diagnostic Hospital; Boston Dispensary; Clinical Professor of Radiology, Tufts College Medical School

BOSTON, MASSACHUSETTS

MANY observers agree that in spite of improved roentgenological diagnosis of gastric lesions, the interpretation of changes in the juxtapyloric area remains a complex problem. The same roentgenological appearance of the prepyloric area may be caused by antral spasm without local cause,[14] by spasm superimposed upon an antral ulcer which cannot be demonstrated, by antral spasm associated with peptic ulcer high in the stomach, by scirrhus cancer, by antral gastritis, and by hypertrophy of the pyloric muscle.[10,11] In addition, certain types of duodenal ulcer may cause confusion by simulating lesions of the prepyloric or pyloric area. Kirklin[11] states that sometimes the only diagnosis possible is that a lesion does exist at the outlet of the stomach. Since the incidence of malignant lesions in the prepyloric area is high, surgical intervention must be the treatment of choice once the presence of a lesion in this area has been established;[9,13] but lesions in the duodenal cap are hardly ever malignant, and therefore surgery need not be the treatment of choice. Although the current mortality of gastric resection is low, accurate differentiation between prepyloric and duodenal lesions is worth while in avoiding unnecessary operations, particularly when the surgical risk is increased by complicating medical disease.

In this paper, some findings in a group of duodenal ulcers will be described where the exact relation of the lesion to the pylorus at first appeared uncertain, but in which definite criteria for localization could be established. The essential diagnostic point in these cases consisted in defining the site of the pylorus. It is well known that the exact localization of the pylorus often presents a problem for the roentgenologist.[5,7] However, the roentgenologist is in a better position to determine the site of the pylorus than the surgeon. According to a recent paper by Russell, Weintraub and Temple[12] who tabulated a comparison of roentgenographic and surgical location of the pylorus in 198 ulcer cases, the roentgen findings were more often correct than the surgical ones.

FIG. 1. Schematic drawing of normal duodenal bulb. A vertical line connecting the superior (*) and inferior (**) recess is considered to be the base line of the cap. It is usually parallel to a vertical line passing through the antrum perpendicular to the plane of the pylorus.

The normal pyloric sphincter, as seen on the roentgenogram, is characterized by two deep, well rounded incisurae which originate at approximately opposing levels from the lesser and greater curvature of the stomach (Fig. 1). The pyloric lumen usually measures not more than about 5 to 10 millimeters in diameter when the

pylorus is open. The cases of duodenal ulcer under consideration had in common that the normal anatomical landmarks of the pylorus were distorted as a result of the duodenal ulcer.

Case 1. In May, 1940, L. R., a male, aged sixty, was admitted to the hospital because of abdominal pain in the right upper quadrant. The pain was dull, came on at irregular intervals, and was not related to food. At times it radiated between the shoulder blades. Nausea and vomiting were infrequently present. There was no history of clay-colored stools or of jaundice. The patient had lost 12 pounds in the past year, but had been under dietary restrictions. The physical examination was not remarkable. The only significant laboratory observation was a moderate anemia (red blood cells. 3.83 million; hemoglobin, 9.3 gm.).

Roentgen examination of the gallbladder revealed tiny, floating stones. Roentgen examination of the stomach on May 21, 1940, showed a large crater in the region of the pyloric valve. The cap did not appear grossly abnormal on the survey film (Fig. 2*A*). On a spot film, convergent folds could be seen to radiate towards the ulcer crater (Fig. 2*B*), and there was also retraction of the superior recess of the cap. Diagnosis was that of a large crater at the outlet

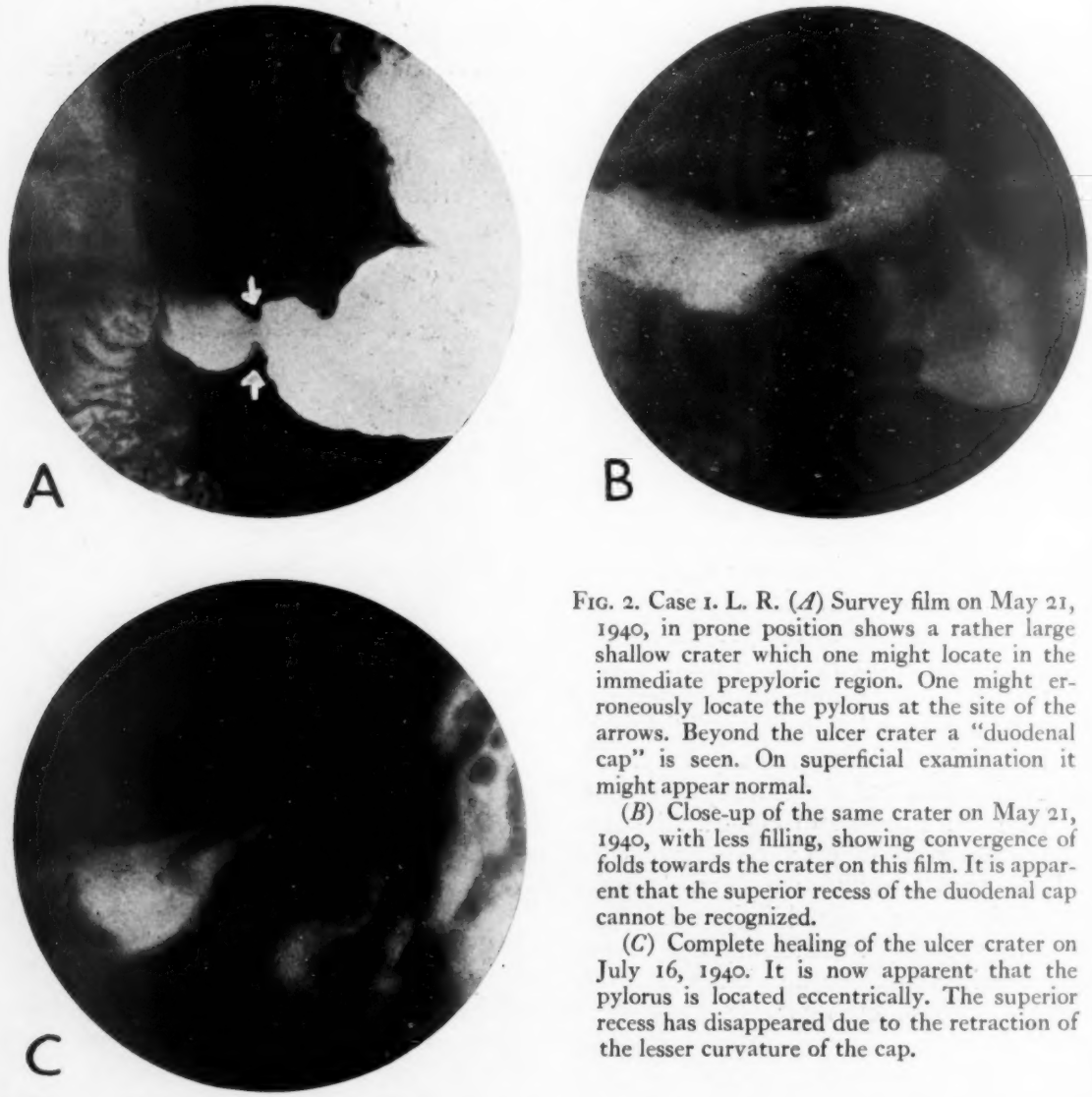

Fig. 2. Case 1. L. R. (*A*) Survey film on May 21, 1940, in prone position shows a rather large shallow crater which one might locate in the immediate prepyloric region. One might erroneously locate the pylorus at the site of the arrows. Beyond the ulcer crater a "duodenal cap" is seen. On superficial examination it might appear normal.

(*B*) Close-up of the same crater on May 21, 1940, with less filling, showing convergence of folds towards the crater on this film. It is apparent that the superior recess of the duodenal cap cannot be recognized.

(*C*) Complete healing of the ulcer crater on July 16, 1940. It is now apparent that the pylorus is located eccentrically. The superior recess has disappeared due to the retraction of the lesser curvature of the cap.

of the stomach. Some uncertainty existed as to whether the lesion was immediately prepyloric or duodenal. Operation was recommended for removal of the gallstones, with the request that the pyloric end of the stomach be explored. At operation, the gallbladder was removed, and the surgeon decided that the ulcer was located in the duodenum and a gastric resection was not done. Roentgenological reexamination two months later showed complete healing of the ulcer crater (Fig. 2*C*). It then became clear that the duodenal cap was markedly distorted, a retraction of the minor curvature side leading to the obliteration of the superior recess, and to an oblique position of the base of the cap. Since both basal recesses are usually at approximately the same level, the duodenal ulcer simulated a prepyloric ulcer in the first examination (May, 1940). Reexamination in December, 1947, over seven years later, showed that the duodenal ulcer had remained healed.

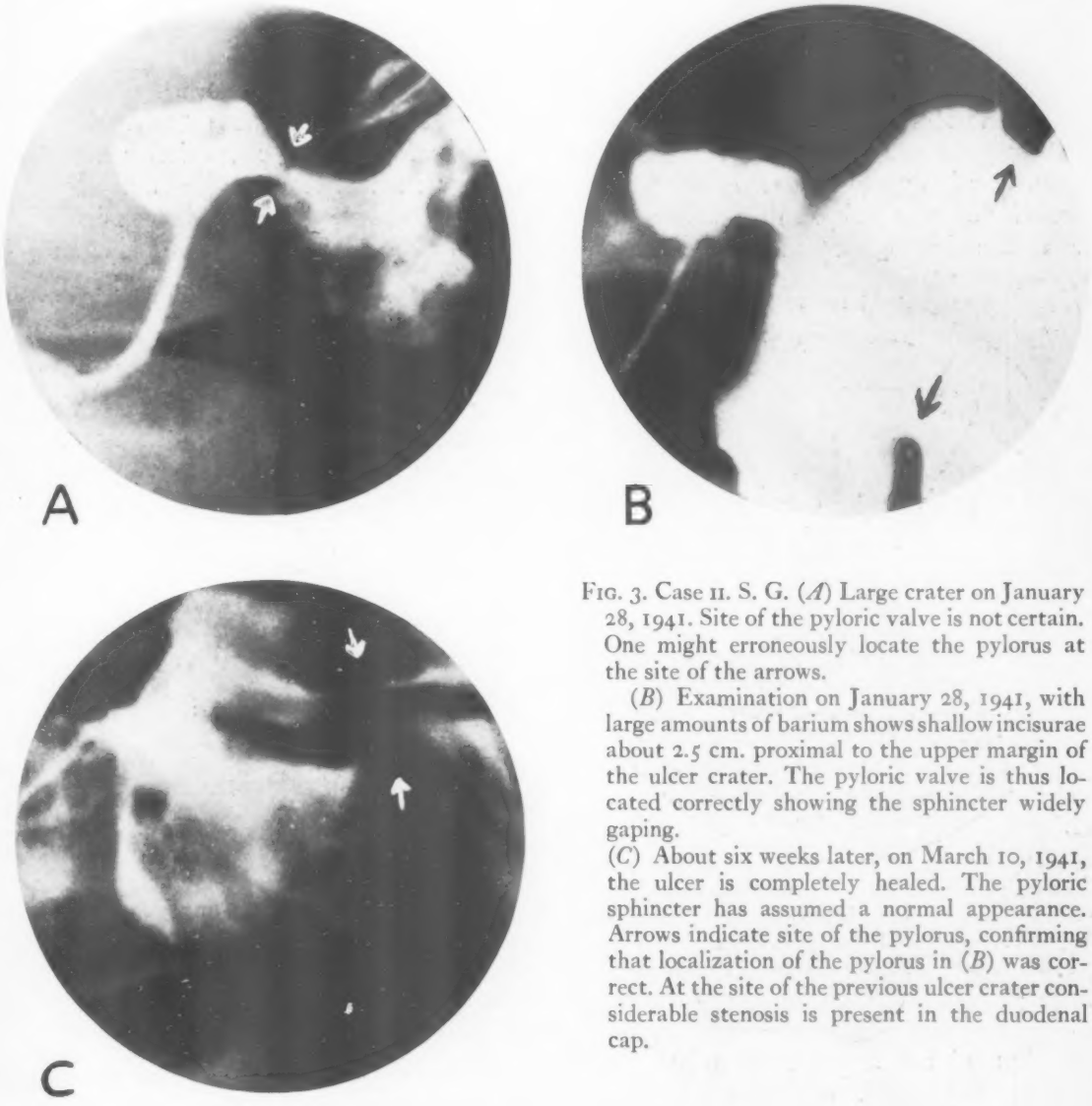

Fig. 3. Case II. S. G. (*A*) Large crater on January 28, 1941. Site of the pyloric valve is not certain. One might erroneously locate the pylorus at the site of the arrows.

(*B*) Examination on January 28, 1941, with large amounts of barium shows shallow incisurae about 2.5 cm. proximal to the upper margin of the ulcer crater. The pyloric valve is thus located correctly showing the sphincter widely gaping.

(*C*) About six weeks later, on March 10, 1941, the ulcer is completely healed. The pyloric sphincter has assumed a normal appearance. Arrows indicate site of the pylorus, confirming that localization of the pylorus in (*B*) was correct. At the site of the previous ulcer crater considerable stenosis is present in the duodenal cap.

While retraction of the lesser curvature side of the bulb is a deformity frequently caused by duodenal ulcer, it did assume unusual proportions in this case, with the result that it obscured the pylorus. Mech-

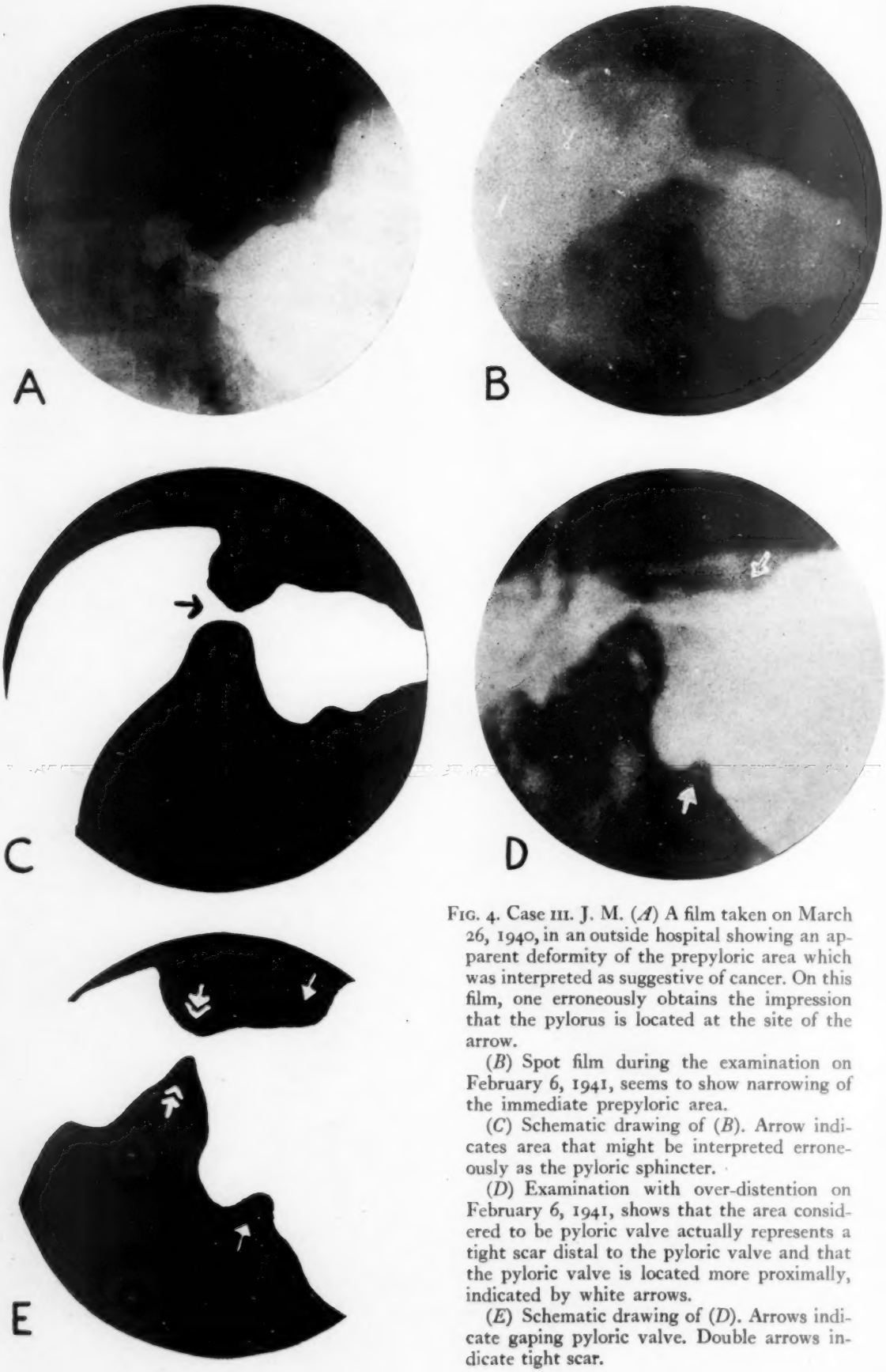

FIG. 4. Case III. J. M. (*A*) A film taken on March 26, 1940, in an outside hospital showing an apparent deformity of the prepyloric area which was interpreted as suggestive of cancer. On this film, one erroneously obtains the impression that the pylorus is located at the site of the arrow.

(*B*) Spot film during the examination on February 6, 1941, seems to show narrowing of the immediate prepyloric area.

(*C*) Schematic drawing of (*B*). Arrow indicates area that might be interpreted erroneously as the pyloric sphincter.

(*D*) Examination with over-distention on February 6, 1941, shows that the area considered to be pyloric valve actually represents a tight scar distal to the pyloric valve and that the pyloric valve is located more proximally, indicated by white arrows.

(*E*) Schematic drawing of (*D*). Arrows indicate gaping pyloric valve. Double arrows indicate tight scar.

anisms causing retraction of the lesser curvature side of the bulb in duodenal ulcer, according to Åkerlund,[1] are spasm of the strong longitudinal muscle, scarring of the wall, infiltration or edema of the mucous membrane.

Another cause for faulty interpretation of the location of the pyloric valve in duodenal ulcer is *pyloric insufficiency*. Attention to the width of the pyloric sphincter in duodenal ulcer will often disclose gaping of the pyloric valve. This is most strikingly present when the ulcer is in the immediate region of the pylorus, but it also occurs when large duodenal ulcer craters are located at a distance from the sphincter. While the term *pyloric stenosis* is familiar in association with duodenal ulcers, the term *pyloric insufficiency* is rarely applied in describing roentgenological signs of duodenal ulcers. It has been mentioned in the classic descriptions of the disease by Åkerlund,[1] Clairmont,[3] and Berg.[2] In later publications, it is only rarely found,[4,6,15] but, without doubt, pyloric insufficiency is a major cause of difficulty in defining the pyloric sphincter.

The following case illustrates that an active duodenal ulcer may produce pyloric insufficiency, and thus may make proper localization of the ulcer difficult.

Case II. In January, 1941, S. G., a male, aged twenty-nine, was admitted to the hospital with "pain in the belly." Ten years before, he experienced gnawing abdominal pain and nausea, lasting about two days. Three months later, he suddenly vomited blood. Following this, he was hospitalized for seven weeks, the diagnosis at that time being "bleeding ulcer." He had another episode of distress eight years later. The present symptoms, characteristic of duodenal ulcer, started one month before admission.

Roentgen examination revealed a stomach filled with large amounts of secretions. The patient lay on his right side for about thirty minutes before the barium was visualized in the duodenal cap. A large ulcer crater, about 1.5 cm. in diameter was seen (Fig. 3*A*). Its location was uncertain at first, but when large amounts of barium were given, the pyloric sphincter was located about 1.5 cm. proximal to the ulcer crater, indicated by symmetrical, shallow incisurae (Fig. 3*B*). The lumen beyond the ulcer crater was exceedingly narrow.

The remarkable roentgenological finding was the widely gaping pyloric valve. That the shallow indentations really indicated the site of the pyloric valve was obvious, when the patient was re-examined two months later. With the healing of the ulcer, the pyloric valve (Fig. 3*C*) had then assumed a more usual appearance.

In this case, the ulcer crater was of unusual size and it produced considerable stenosis of the duodenal cap by associated inflammatory changes. In order to overcome the stenosis, large amounts of contrast substance had to be given to elicit strong peristaltic action, thus raising the intragastric pressure. Spot films taken during the onrush of strong peristaltic movements showed shallow symmetrical incisurae indicating the pyloric sphincter in a widely gaping state, making the duodenum appear practically fused with the antral portion of the stomach. The wide gaping must have been partially a functional state, because the pyloric valve had regained its normal configuration, when the patient was re-examined two months later.

The next case demonstrates that pyloric insufficiency may also be produced by a scar of a duodenal ulcer.

Case III. J. M., a male, aged thirty-six, was admitted to our hospital in February, 1941, because of epigastric distress of six years' duration. He complained of pressure sensation beneath the lower end of the sternum and of sour eructations. These were relieved on a Sippy regimen. Five years later the distress recurred. Six weeks before admission to our hospital, he had another episode. Roentgen examination in another hospital (Fig. 4*A*) was thought to show a prepyloric lesion. Cancer was considered likely and operation recommended.

Roentgen examination after admission to our hospital in February, 1941, appeared at first to confirm the diagnosis of a prepyloric lesion. The initial impression was that there was a narrowing of the antrum (Fig. 4*B*). The pylorus was believed to be at the distal portion of the contracted area and an undeformed cap seemed to be present beyond the apparent pylorus (Fig. 4*C*).

On roentgenoscopic observation, however,

the part that had seemed to be the pyloric ring completely lacked the normal movements of the sphincter; it remained constantly narrow, thus proving not to be the pyloric valve but a contracted ulcer scar. The pyloric sphincter was located more proximal, indicated by shallow incisurae (Fig. 4*D*), which were seen only when strong peristaltic movements were stimulated by large amounts of barium.

The scarring had apparently produced two effects. It had shrunk both basal recesses of the cap to such a degree that they did not unfold except when a large amount of barium distended them for fleeting moments; it had involved the pyloric sphincter, keeping it widely gaping (Fig. 4*E*), thus interfering with its function of proper closure. This pyloric insufficiency was responsible for the difficulties encountered in determining the site of the sphincter. The diagnosis in this case was: Deformed duodenal cap due to previous duodenal ulcer very close to the pyloric valve, producing pyloric insufficiency. Operation was not advised at this time.

Because of persistent symptoms, a gastric resection was done one year later. The pathologist reported marked hypertrophy of the pyloric muscle, but found no evidence of a prepyloric lesion or of a duodenal ulcer in the resected specimen. The surgeon, however, reported that he saw a definite scar adherent to the pancreas and gastrohepatic omentum on the duodenal side of the pylorus. From these facts, it is obvious that the pyloric insufficiency was produced by a scar close to the pyloric valve.

Clairmont[3] has described in pathological material what he terms the "arcade-like" distortion of the pyloric valve due to scarring of healed duodenal ulcer involving the pyloric muscle.

A gaping pyloric valve may be concurrent with duodenal ulcer in various stages of activity. It may be caused by either anatomic or functional mechanisms, or possibly by both. Berg[2] states that a gaping pylorus may be produced by nervous influences, inflammatory processes, lack of hydrochloric acid, infectious or neoplastic infiltrations, or distortion by adhesions of postbulbar stenosis. Alterations due to nervous influences are well illustrated by studies of duodenal ulcers by Gershon-Cohen.[8] He showed that rapid emptying through an open valve frequently occurs due to severe disturbances of the "duodenal mechanism," which normally regulates closure and opening of the pyloric sphincter. Undoubtedly, it will often require serial observations to determine whether the pyloric insufficiency is of a functional or of a permanent anatomical character.

SUMMARY

In this paper two causes of confusion in the roentgenological differentiation of duodenal ulcers from prepyloric lesions are described. These are (1) excessive foreshortening of the lesser curvature side of the cap, which may involve the antrum, and (2) pyloric insufficiency. Criteria for their recognition and three illustrative cases are presented.

Joseph H. Pratt Diagnostic Hospital
30 Bennet St.
Boston 11, Mass.

REFERENCES

1. Åkerlund, Å. Die Röntgendiagnostik des Ulcus duodeni mit Hinsicht auf die lokalen "direkten" Röntgensymptome. *Mitt. a. d. Grenzgeb. d. Med. u. Chir.*, 1923, *36*, 577–590.
2. Berg, H. H. Die direkten Röntgensymptome des Ulcus duodeni und ihre klinische Bedeutung. *Ergebn. d. med. Strahlenforsch.*, 1926, *2*, 249–350.
3. Clairmont, P. Die pathologisch-anatomischen Veränderungen des Duodenums bei Ulkus und deren Darstellung im Röntgenbild. *Würzb. Abh. f. prakt.*, M.21, neue Folge 1 H. 1, Leipzig, 1923.
4. de Abreu, M. Entzündliche Verengerung des Pylorus. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1933, *48*, 558–575.
5. Doub, H. P. Differential diagnosis of pyloric and prepyloric ulceration. Am. J. Roentgenol. & Rad. Therapy, 1940, *43*, 826–831.
6. Eusterman, G. B., and Balfour, D. C. The Stomach and Duodenum. W. B. Saunders Company, Philadelphia, 1935.
7. Garland, L. H. Roentgen diagnosis of duodenal ulcer. *Radiology*, 1930, *14*, 482–487.
8. Gershon-Cohen, J. Duodenal mechanism regulating motor and secretory activity of stomach; its roentgenographic disturbance in duodenal ulcer. *Radiology*, 1947, *48*, 232–238.
9. Holmes, G. W., and Hampton, A. O. Incidence of carcinoma in certain chronic ulcerating lesions of the stomach. *J.A.M.A.*, 1932, *99*, 905–909.

10. Jordan, Sara M., and Lahey, F. H. Prepyloric lesions of the stomach; medical and surgical aspects. *Gastroenterology*, 1943, *1*, 1–12.

11. Kirklin, B. R. Mistakes and misunderstandings in roentgenologic diagnosis of gastric cancer. *Arch. Surg.*, 1943, *46*, 861–864.

12. Russell, W. A., Weintraub, S., and Temple, H. L. Analysis of x-ray findings in 405 cases of benign gastric and pyloric ulcer. *Radiology*, 1948, *51*, 790–797.

13. Sampson, D. A., and Sosman, M. C. Prepyloric ulcer and carcinoma. Am. J. Roentgenol. & Rad. Therapy, 1939, *42*, 797–810.

14. Sandström, C. On gastrospasm and its roentgenological appearance. *Acta radiol.*, 1944, *25*, 765–795.

15. Stone, R. S., and Ruggles, H. E. Diagnostic value of prepyloric and pyloric roentgen findings. Am. J. Roentgenol. & Rad. Therapy, 1932, *27*, 193–204.

ROENTGEN EXAMINATION IN MESENTERIC THROMBOSIS*

By J. FRIMANN-DAHL, M.D.
OSLO, NORWAY

MESENTERIC thrombosis is a most serious acute abdominal lesion caused by obliteration of the mesenteric vessels by a thrombus or embolism. The clinical diagnosis is often doubtful and is seldom made preoperatively. The condition may

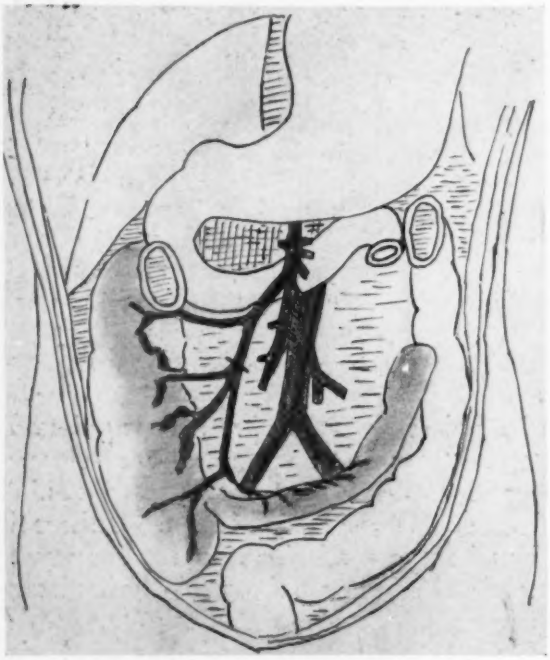

FIG. 1. Schematic drawing of necropsy findings in a case of mesenteric thrombosis. Note site of thrombus above division of superior mesenteric artery.

simulate, for instance, a perforated ulcer, a strangulating obstruction or an acute peritonitis. Usually signs in the history of any circulatory disorder or vascular disease may give rise to the suspicion that a mesenteric thrombosis or embolism is present. Blood in the stool may indicate the presence of an intestinal infarction, and should be remembered as an important finding in the differential diagnosis.

In recent years some few observations on the *roentgen examination* in such cases have been published inter alia by Mondor, Rendich and Harrington. These authors emphasize the possibility of demonstrating these vascular accidents by means of such examinations.

Prior to a discussion of my own experiences a short survey of the condition is given.

Thrombosis or embolism may occur anywhere in the mesenteric vessels. The general cause has been classified as cardiovascular, infectious and mechanical. The lesion appears more frequently in the arteries than in the veins and is forty times more frequent in the superior than in the inferior mesenteric artery. Usually a local arteriosclerotic ulceration is found at the site of the thrombus. Such lesions of the artery are in the majority of the cases the primary cause of the infarction. This fact explains also that the lesion is rarely seen in persons under forty and is more frequent in men than in women.

The extent of the lesion depends upon the course of the mesenteric vessels in each case, and on the localization of the thrombosis in their branches

Normally the superior mesenteric artery divides into two smaller branches: the arteria colica dextra and the arteria ileocolica (Fig. 1). The site of predilection of thrombo-embolic occlusion is just above the division of these arteries. Consequently the vascular supply of the lower ileum and parts of the ascending colon and cecum are compromised.

Many cases of mesenteric occlusion run a fairly mild course and weeks may elapse before the existence of such a lesion is suspected. Usually, however, soon after

* From the Roentgen Department of Ullevål Hospital, Oslo, Norway. (Chief: J. Frimann-Dahl, M.D.)

vascular obturation the intestine becomes the seat of an infarct. The color is changed to dark red and the wall increases in thickness because of edema and hemorrhage.

Experimental investigations have proved that soon after occlusion of the vessels fluid and gas are collected in the dilated involved loops (Hibbard, Swenson and Levin). Simultaneously an increased motor activity may be observed, quite in agreement with clinical experience which teaches that profuse initial diarrhea may occur, and that at an early stage borborygmi are heard during auscultation of the abdomen.

However, in most cases a more or less extensive paralysis is found soon after the obturation. Gradually gangrene develops and the clinical picture is finally dominated by a diffuse peritonitis.

Frequently violent, often persistent pains occur and usually only few sounds are heard. Shock is often manifest in later stages and the pulse is rapid and irregular. Presence of blood in the stool and vomiting are emphasized by many writers, and should be recognized as an important symptom in the differential diagnosis.

Despite these signs, mesenteric thrombosis is rarely recognized preoperatively. The importance of a correct diagnosis is emphasized by the fact that although this lesion has a very high mortality rate, timely operation should offer a relatively good prognosis.

The *roentgen diagnosis* varies according to the site of the thrombosis and the extent of the intestinal infarct, but in addition it depends especially on how early the patient is examined.

Observers have reported visible distended loops as early as three to four hours after onset of the attack. As a rule, it may be said that occlusion of arteries supplying the small intestine presents signs in this area, while occlusion of vessels supplying parts of the colon results in distention and circulatory changes of a corresponding section of the large bowel.

As in all acute abdominal disorders roentgenoscopy should be performed in cases of acute mesenteric thrombosis because deformity of the heart shadow may excite suspicion of a cardiovascular disease, thereby giving support to the diagnosis of the abdominal lesion.

Our Material. In our material consisting of 17 cases of mesenteric vascular occlusion examined during the last ten years, rather markedly varying signs were found.

The result of treatment has been discouraging and only 3 patients have survived. In order to investigate the roentgen findings more closely and to examine the possibilities of a more definite diagnosis and better results of treatment this study has been undertaken. Mesenteric thrombosis has been studied thoroughly by surgeons and pathologists for years, but only few papers are published concerning the roentgen diagnosis of these lesions.

Fig. 2. Acute mesenteric thrombosis ten hours after onset of symptoms.

Nearly all of our cases showed the common feature of distended small intestinal loops containing gas and fluid levels. The

Fig. 3. Six hours later, remarkable increase in gaseous distention.

first impression gained may be that of a simple mechanical occlusion (Fig. 2). This roentgenogram shows gas-filled small intestinal loops with fluid levels. The single loops are not markedly hoop shaped as in mechanical obstruction and the levels are shorter. We may note some difference in the height of the levels but obviously the movements are limited. The patient was examined repeatedly and a marked increase in number and size of distended loops was disclosed within the course of a few hours (Fig. 3). This sign should be accurately observed because it may give clues to a correct diagnosis. Such a rapid increase in the number of affected loops can scarcely ever be observed in simple mechanical obstructions.

Also, as previously stated, signs of some intestinal activity may be observed clinically. The mechanism in such cases of relatively circumscribed infarct formation is probably that the involved segment when paralyzed acts as a hindrance to the passage, and that the proximal loops consequently are in a state of mechanical ileus.

In severe cases, where the vascular lesion is more extended, the picture may be dominated by the dilated small intestinal loops (Fig. 4). In this case 2.75 meters of small intestine were resected resulting in death two days later.

The question now arises if examination after oral barium may give further evidence and more reliable criteria for the diagnosis. We have tried that in some cases. In this connection it must be considered that one may argue that such examination is not indicated because surgical intervention is urgent. Certainly that is true, but, on the other hand, the clinical signs are often so few that the patient must be observed for some time prior to the final decision of an operative intervention. In this space of time a roentgen observation may be accomplished.

When the small intestine is mainly

Fig. 4. Acute mesenteric thrombosis twenty-seven hours after onset of attack. Greatly distended small intestinal loops, simulating simple obstruction.

affected a remarkable retention of contrast medium is seen in the involved loops (Fig. 5, *A* and *B*). It should be noted that the small intestinal loops are not so dilated as in pure mechanical obstruction and that the mucous membrane pattern shows signs of thickening and rigidity, obviously due to present edema. The folds are relatively small, standing close together with the contours irregularly serrated.

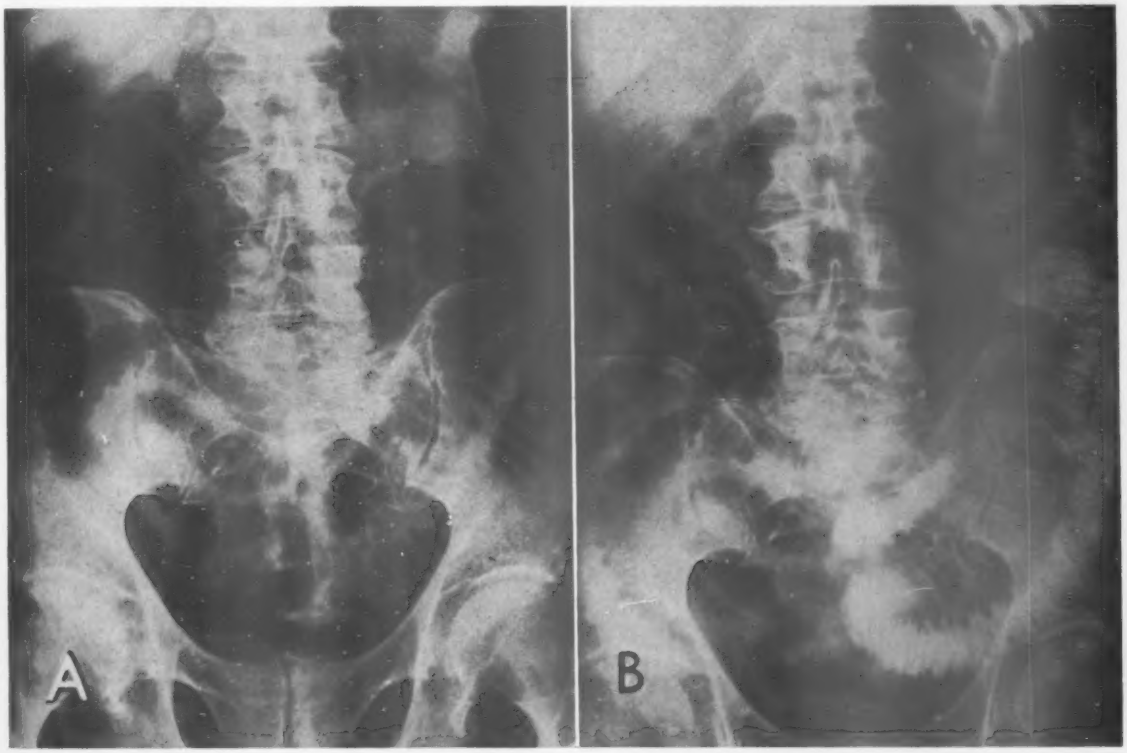

Fig. 5. (*A*) Survey film of abdomen showing gas-filled involved small intestinal loops. (*B*) Six hours later. Oral barium. Stereotyped markings in paralyzed loops.

Re-examination the next day revealed a retention of contrast medium in the involved loops which showed stereotyped markings. A nearly complete paralysis is apparent, as the coils are curved downward and are nearly motionless.

The findings proved at once that no mechanical occlusion was present, but difficulties arose as to the differential diagnosis for instance of an acute jejunitis. In this lesion also segmental involvement of small intestinal loops may be disclosed and barium is retained in the affected loops. However, certain criteria exist as to a correct distinction. It should be remembered that acute jejunitis is more apt to affect the upper loops of the jejunum (distended by gas) visible upward and to the left, often leaving the lower ileum unaffected. The retention of barium in such cases is also remarkable but the contrast may, on the other hand, reach the cecum in the course of ten to twelve hours, leaving a fine coating of barium on the walls of the involved loops.

As a rule, portions of the colon are also affected in acute mesenteric thrombosis and correspondingly distended by gas. This is explained by the fact that branches of the mesenteric superior artery supply segments of the lower ileum and the ascending colon (Fig. 6*B*). This film made in left lateral recumbency is that of a case in which the thrombosis was detected just above the

division of these arterial branches (see Fig. 1). The anteroposterior film in supine position showed small intestinal coils containing gas and fluid levels right down to barium enema passed freely by and reached the cecum without signs of any hindrance. These features are in some way confirmed by our experiences, but in our cases the

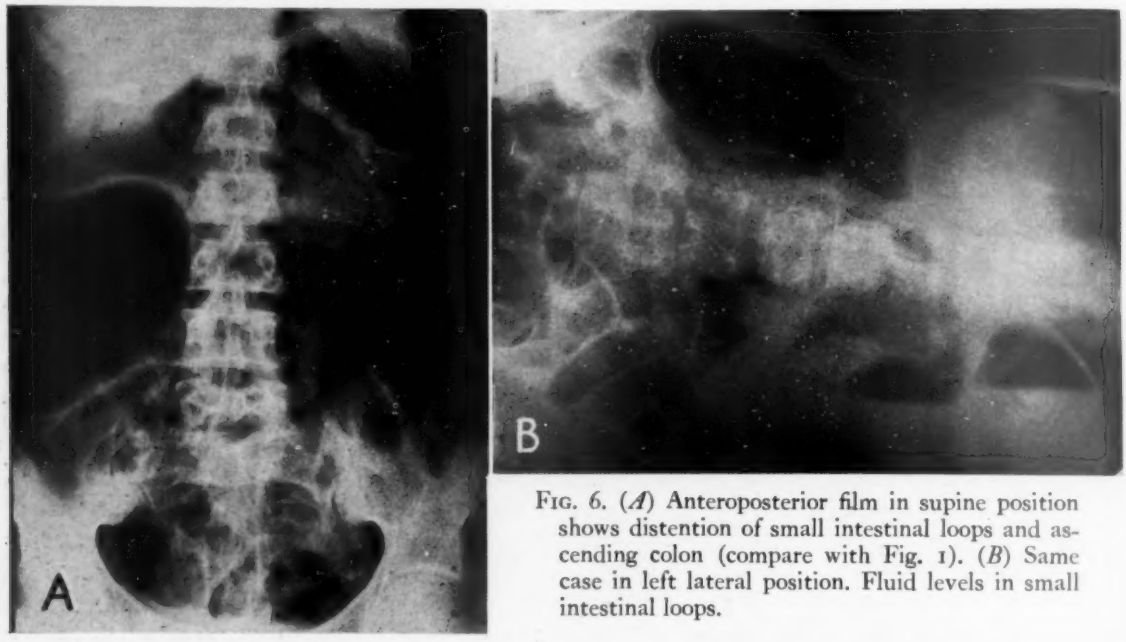

Fig. 6. (*A*) Anteroposterior film in supine position shows distention of small intestinal loops and ascending colon (compare with Fig. 1). (*B*) Same case in left lateral position. Fluid levels in small intestinal loops.

the lesser pelvis and some fluid collected in the peritoneal cavity (Fig. 6*A*).

The findings show that the features may also resemble a colonic obstruction, but it should be observed that there are no distinctly marked fluid levels in the large intestine. However, in other cases fluid levels may be observed in parts of the colon though they are not so distinctly apparent as in pure mechanical obstructions.

In another case of acute mesenteric thrombosis a similar distribution of circulatory disturbances was found at necropsy (Fig. 7). In this case also the lower ileum and the ascending colon were involved.

Rendich and Harrington have reported cases of mesenteric thrombosis where a remarkable distention of the colon was found with a characteristic demarcation of the gas column sharply halted corresponding to the splenic flexure. However, the

Fig. 7. Specimen of mesenteric thrombosis showing vascular changes in ileal loops and involved ascending colon.

gaseous distention has been more distinctly demarcated at the hepatic flexure. We have not had the opportunity to check the findings by means of a barium enema.

As to the *differential diagnosis*, as mentioned above, acute regional enteritis must be taken into account. The plain film in acute ileitis shows signs of a peritoneal irritation with gas and fluid levels in the lower ileum and the ascending colon. The loops are not distinctly hoop shaped and the levels in the colon are often fragmented.

Mesenteric thrombosis should not be confused with a mechanical obstruction of the small intestine. In the latter condition the loops are definitely hoop shaped showing signs of increased motor activity and practically no gas is present in the colon, nor are fluid levels revealed in that portion of the intestine.

One of our cases showed remarkable findings for a comparative study of this distinction. One year prior to admission with mesenteric thrombosis the patient was examined and operated upon because of an acute abdominal occlusion (Fig. 8*A*). This film shows typical findings of an acute obstruction. We should observe the hoop-shaped small intestinal loops and the absence of gas and fluid in the colon. Figure 8*B* shows the condition one year later when the patient was suffering from an acute mesenteric thrombosis. The film reveals slightly distended small intestinal loops with small levels and some gas in the paralyzed cecum. The patient was successfully operated upon.

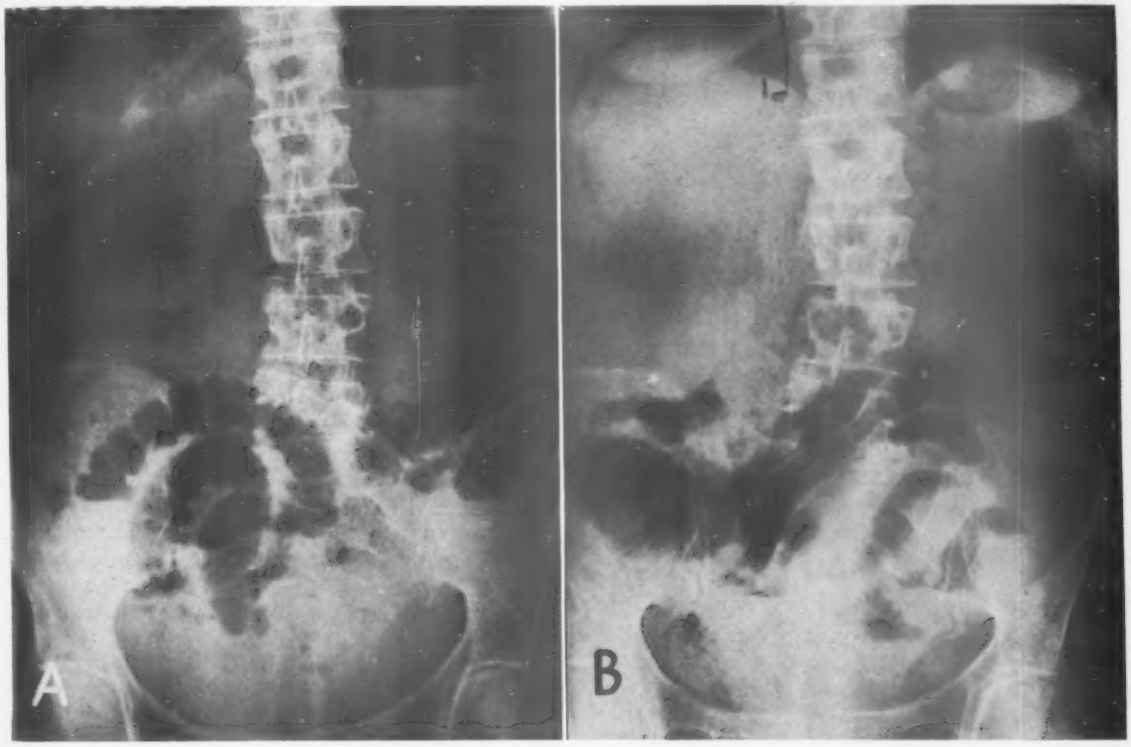

Fig. 8. (*A*) Case of acute intestinal obstruction of lower ileum due to adhesive bands. (*B*) Acute mesenteric thrombosis in same patient one year later (successfully operated upon).

Thus, considering the various signs described above, the roentgen examination should bring about strong evidence for an adequate diagnosis. But, nevertheless, it must be realized that cases may be encountered where an exact decision is impossible.

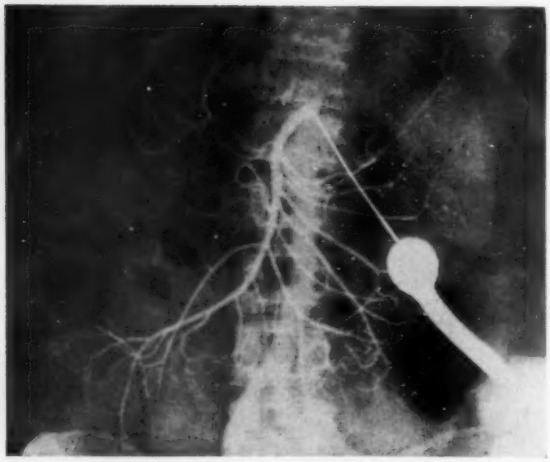

Fig. 9. Mesenteric vessels shown by arteriography.

The question arises whether there is any other method which would give the final proof preoperatively. As far as can be seen this is rather difficult at the present stage of diagnosis. The only means here suggested is the probability of arteriography, either aortography or mesenteriography. In one case (without mesenteric thrombosis) we succeeded in showing the mesenteric artery (Fig. 9). On the original film the smallest vessels even out in the serosa are shown so that one could imagine the possibility of demonstrating a thrombus of even the smallest vessels. However, the question whether this method may gain any practical application in the diagnosis of acute mesenteric thrombosis must at present be unanswered.

SUMMARY

Roentgen examination in acute mesenteric thrombosis offers great difficulties in the diagnosis. The findings are in some way characteristic but may simulate a mechanical obstruction of either small or large intestine, or an acute ileojejunitis. Oral barium is at times of valuable aid in the diagnosis, and barium enema may exclude obstruction of the large bowel. Possibly future arteriographic experiences (mesenteric angiography) may contribute to an adequate diagnosis.

Ullevål Hospital
Oslo, Norway

REFERENCES

1. Harrington, L. A. Mesenteric thrombosis. Am. J. Roentgenol. & Rad. Therapy, 1947, *58*, 637–640.
2. Hibbard, J. S., Swenson, P. C., and Levin, A. G. Roentgenology of experimental mesenteric vascular occlusion. *Arch. Surg.*, 1933, *26*, 20–26.
3. Mondor, H. Diagnostics urgents: Abdomen. Masson & Cie, Paris, 1943.

Vol. 64, No. 4

GAS-CONTAINING BILIARY CALCULI*

By C. L. HINKEL, M.D., Med. Sc.D.
DANVILLE, PENNSYLVANIA

ROENTGENOLOGICAL examination of the gallbladder unquestionably represents the most accurate means of diagnosis of calcareous cholecystitis. Despite constantly improving techniques, however, there is still an appreciable disparity between the roentgen diagnosis and the operative and autopsy findings. Errors of omission are far more frequent than errors of commission in this regard, as non-opaque calculi are frequently overlooked or not demonstrated.

The roentgenological diagnosis of calcium-containing biliary calculi is almost invariably correct. The cholecystographic diagnosis of opaque or non-opaque biliary calculi in a well functioning gallbladder is highly accurate. A "non-visualized" gallbladder on the cholecystogram is subject to considerable error in appraisal.

As a general rule, a plain roentgenogram of the right upper abdomen reveals the presence of opaque gallstones, and does not reveal non-opaque calculi. The exception to this is the rare instance in which there is something of contrasting lesser density such as gas within the gallbladder or within the calculi themselves which renders them visible. It is the latter which we wish to discuss here.

Stellate gas collections within biliary calculi have been recognized, especially in Europe, since 1931,[4] but the rarity, the unusual interest, and the roentgenological significance of this finding appear to justify re-emphasis and the report of some additional observations. In the following report, the calculi contained no calcium, and there was non-visualization of the organ on cholecystography. The diagnosis of biliary calculi was, of necessity, based entirely upon the finding of gas within fissures in the calculi.

CASE REPORT

F. P., white male, aged forty-four (Hospital No. 162,185) was admitted to the hospital November 11, 1948, complaining of severe right upper abdominal pain.

Present Illness. On three occasions in the last year the patient suffered severe attacks of upper abdominal pain, usually coming on in the late evening or night. These were not relieved by soda, induced vomiting, or other measures, and on two occasions morphine had been administered by the family physician with partial relief. No jaundice, fatty food intolerance, diarrhea, or spontaneous vomiting.

Physical Examination. Essentially negative.

Laboratory Studies. Negative except for the following blood count: red blood cell count, 4,840,000; white blood cell count, 12,300, with 69 per cent neutrophils, 22 per cent small lymphocytes, 2 per cent large lymphocytes, 4 per cent monocytes, and 3 per cent metamyelocytes.

Roentgen Examination. Plain film of the abdomen: "No opacities in right upper quadrant. Several star-shaped gas shadows are present in the expected position of the gallbladder. These are attributed to gas-containing fissures in biliary calculi."

Cholecystogram: "Non-visualized gall bladder. The star-shaped gas shadows are better seen than at the first examination. There are four of these, indicating at least four non-opaque calculi" (Fig. 1).

Operation. On November 17, 1948, a cholecystectomy was done. The gallbladder was found to be distended and to contain a number of calculi. The specimen was taken immediately to the Department of Radiology.

Pathological Report. Gross: Specimen is recognized as gallbladder. The measurements are 13 by 5 by 4 cm. The pink-white external surface is smooth and glistening. The organ is quite distended and numerous calculi are palpable within its lumen. With incision of the homogeneously firm, tan-gray, 0.3 cm. wall, there is the escape of 50 cc. of yellow-black

* From the Department of Radiology, George F. Geisinger Memorial Hospital and Clinic, Danville, Pennsylvania.

Fig. 1. Cholecystogram of right upper quadrant. No gallbladder shadow is seen. There are four radiolucent star-shaped shadows arranged in linear fashion. Gas-filled fissures within non-opaque calculi (arrows).

glistening, viscid bile. The yellow-brown mucosa is velvety to palpation, and there is no evidence of ulceration or calcium deposition. Contained within the lumen are numerous firm, multifaceted, polyhedral, black-brown calculi. These calculi vary from 0.3 cm. to 1.5 cm. in diameter. Five of these large polyhedral calculi are present.

Microscopic: Tissue is recognized as originating from gallbladder. Along one border of the section in a flattened, atrophic, but well differentiated mucosa is a diffuse infiltration with lymphocytes and plasma cells. In many areas within the muscularis, the muscle fibers have been replaced with fibrous connective tissues.

Diagnosis. Chronic cholecystitis and cholelithiasis.

Further Studies. Roentgenograms of the five large calculi were made, both in air (Fig. 2*A*) and in water. (It was noted that one of the calculi floated in water at this time.) No calcium or other opaque material was seen. When immersed in 5 cm. of water, the calculi were invisible on the roentgenograms but the contained stellate gas shadows were readily seen (Fig. 2*B*).

One of the calculi was sent to the laboratory for determination of specific gravity. This was found to be 0.822.

An attempt was made to section one calculus, but it proved to be very friable, and broke into three segments on handling. All the surfaces of the broken segments were moist. There was no odor. Re-examination by roentgenography revealed absence of the previously seen gas star, indicating that the splitting had occurred along the lines of pre-existing fissures.

Because certain individuals expressed doubt as to the actual presence of gas within the calculi, another intact calculus was placed in a rubber condom. The condom was filled with mineral oil (which had been previously heated to drive off air bubbles) and the end was clamped to prevent the entrance of extraneous gas. The calculus was then struck with a soft hammer while in the oil-filled condom. The calculus split into three approximately equal segments, and a bubble of gas appeared simultaneously in the oil. The calculus before and after splitting is shown in Figures 3*A* and 3*B*. The gas was not subjected to chemical analysis.

Another of the calculi was quickly flamed and split open under sterile precautions. The fragments were cultured for aerobic and anaerobic organisms. There was no growth.

Roentgenological Study of Dried Biliary Calculi

It has been known for years that stored, dried gallstones sometimes contain central cracks and fissures which may be seen roentgenologically or on sectioning the calculi. In order to determine the approximate incidence of this phenomenon, the author secured the dried gallstones removed from 150 random cholecystectomy patients between 1946 and 1949 at this institution. The gallstones had been kept in small cardboard boxes marked with the patients' number and it was possible to obtain roentgenograms of these without opening the boxes. The boxes were entirely unselected, and the contained calculi varied greatly in number, size, color, weight, shape and mineral content. Study of the roentgenograms of the 150 boxes of calculi disclosed 20 cases of central fissuring. The 20 boxes of fissured biliary calculi are shown collected on a single roentgenogram in Fig-

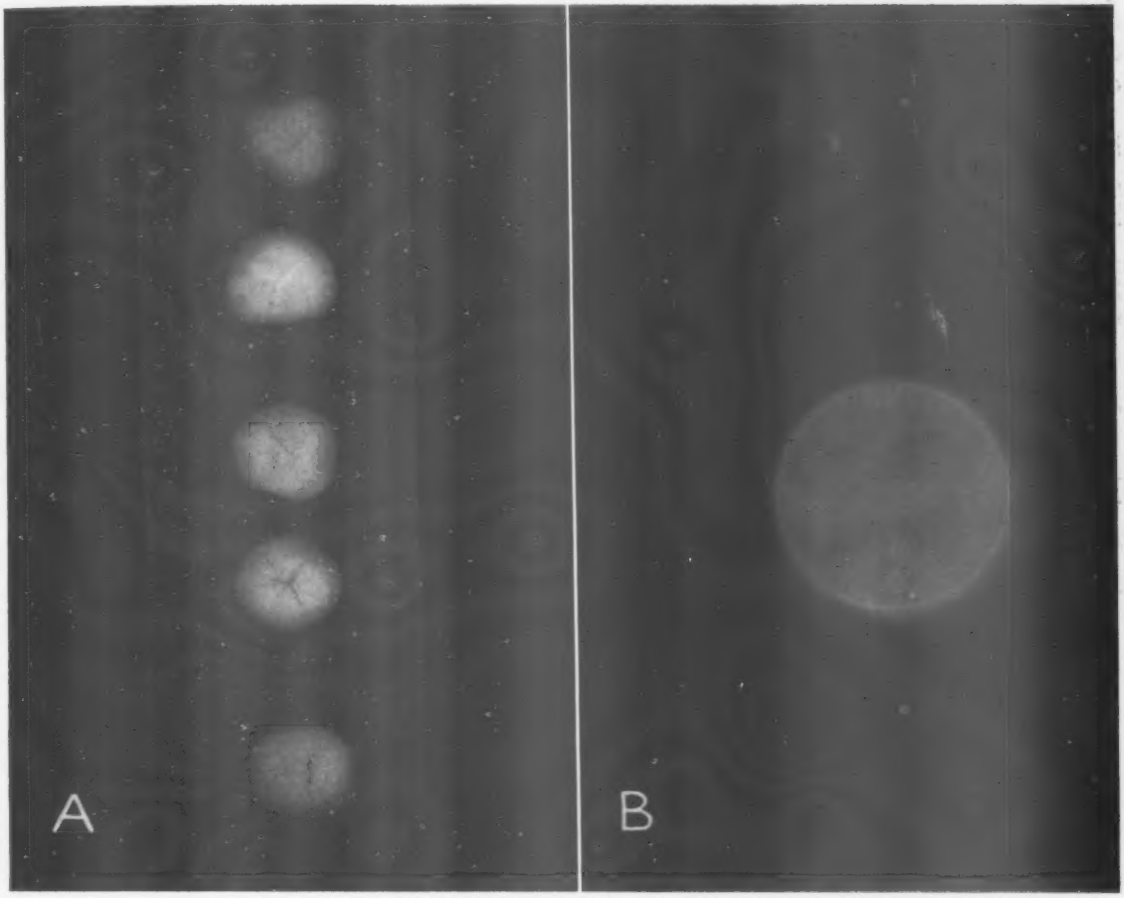

Fig. 2. (*A*) Immediate postoperative film of the five calculi in air. All are fissured. All but the second from the top contain gas. (*B*) Same five calculi in a paper cup containing water to a depth of 5 cm. Only the gas-filled fissures can be seen.

ure 4. A brief summary of these 20 cases of fissured calculi follows:

Number of boxes of dry gallstones studied roentgenologically	150
Number showing central fissures	20
Per cent showing central fissures	13.3

Breakdown of the 20 cases showing fissures (Fig. 4).

Roentgenological characteristics:	
Generally opaque	0
Entirely non-opaque	12
Largely non-opaque with a central dense nidus	6
Showing concentric layers of varying density	2

Size. The size of individual calculi was of no significance as the fissures were found in some calculi only 5 mm. in diameter as well as in the larger variety.

Number. The number of calculi per patient was not significant as the number varied from two to sixty. It is interesting to note that in the "selected positive group" shown in Figure 4 when a patient had fissuring of calculi, all or nearly all of the calculi in that particular case showed fissures. The implication is that all the calculi in a given gallbladder have approximately the same composition, structure and crystalline arrangement.

Review of roentgenograms in vivo. Working backwards from the dried boxes of gallstones in which typical fissures were found, the preoperative roentgenograms were secured and reviewed in order to determine whether or not the fissures might be recognized in retrospect.

Of the 20 known fissured cases, 2 had no preoperative films.

In the 18 remaining, only 1 clear-cut case of gas-filled fissures was observed in a cholecystographic series. The stellate gas shadows are unmistakable in a non-visualized gallbladder but as the case is practically identical with the case reported at length in this paper it will not be discussed.

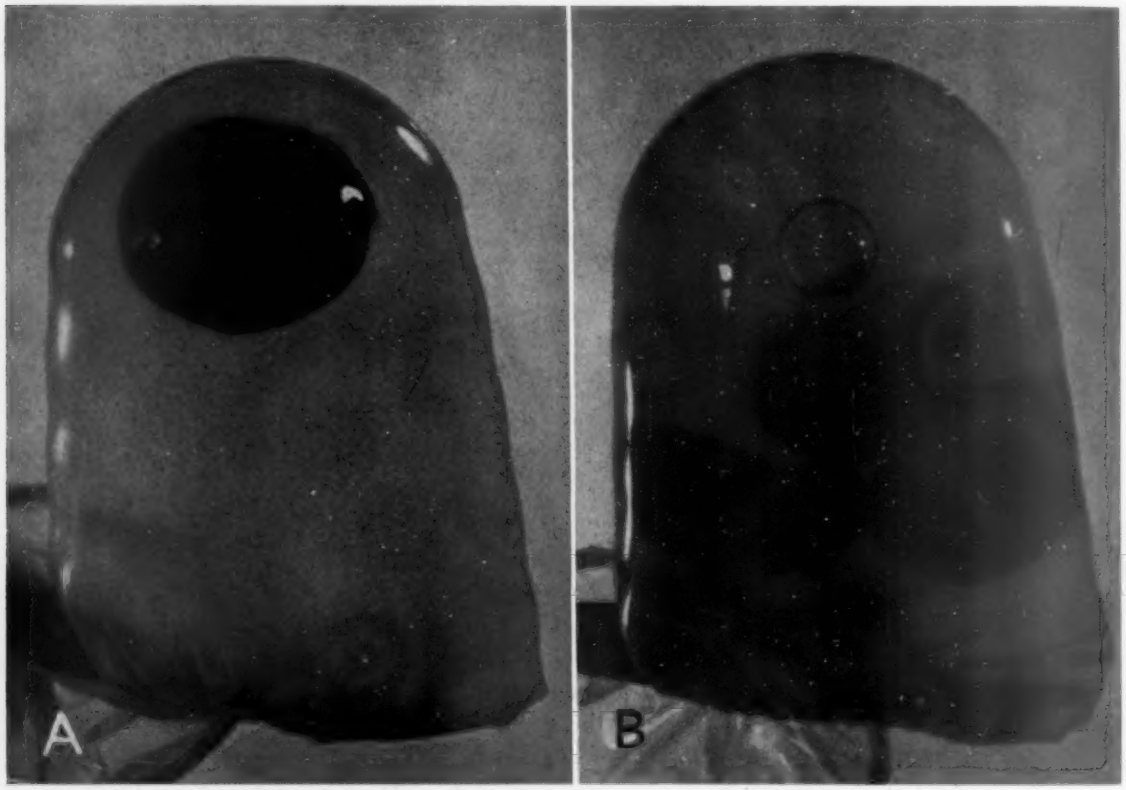

Fig. 3. (*A*) Intact calculus within condom filled with bubble-free mineral oil. Photograph ×1.5. (*B*) Fragmented calculus after hammer blow. A gas bubble is now free in the oil. Photograph ×1.5.

The dry calculi are seen in the third box to the right in the top row (Fig. 4).

Seventeen cases had preoperative cholecystograms while 1 had only a plain film of the abdomen which disclosed semi-opaque ring calculi. The 17 cases having cholecystograms were classified as follows on review:

Normally concentrating gallbladder:	
Containing opaque calculi	0
Containing non-opaque calculi	7
Non-visualized gallbladder:	
Opaque calculi	1
Gas-filled fissures in non-opaque calculi	1
No calculi seen in gallbladder region	8

COMMENT

Our failure to recognize gas-filled fissures in retrospection (in all but 1 instance) is disappointing, but probably explained upon the basis that: (a) The fissures were not present at the time the films were made, but developed after removal during the long storage period in atmospheric air. (b) The fissures were present but were filled with bile or other substance which failed to render them visible on the cholecystographic films.

Investigations of these two possibilities are now under way and will be reported subsequently.

THE FISSURING PHENOMENON

Much has been written concerning the central fissures described here, and many widely divergent theories have been suggested. Åkerlund[1] believed that the gas

was formed by bacterial action and organic decomposition. Kommerell and Wolpers[7] stated that all calculi at some time pass through a gas-containing phase. Other European writers have advanced different theories, and Delario[6] has shown that in some cases, at least, the crystallization begins peripherally extending inward to include the central fluid portion last. Bauer has outlined the lines of force in pyramidal and cube-shaped calculi which determine the planes along which splitting occurs, in an effort to explain autofragmentation and spontaneous disintegration. We shall make no effort to review all theories as the historical aspects have been covered in Ortmayer and Connelley's paper[8] which is the only American treatise on this topic.

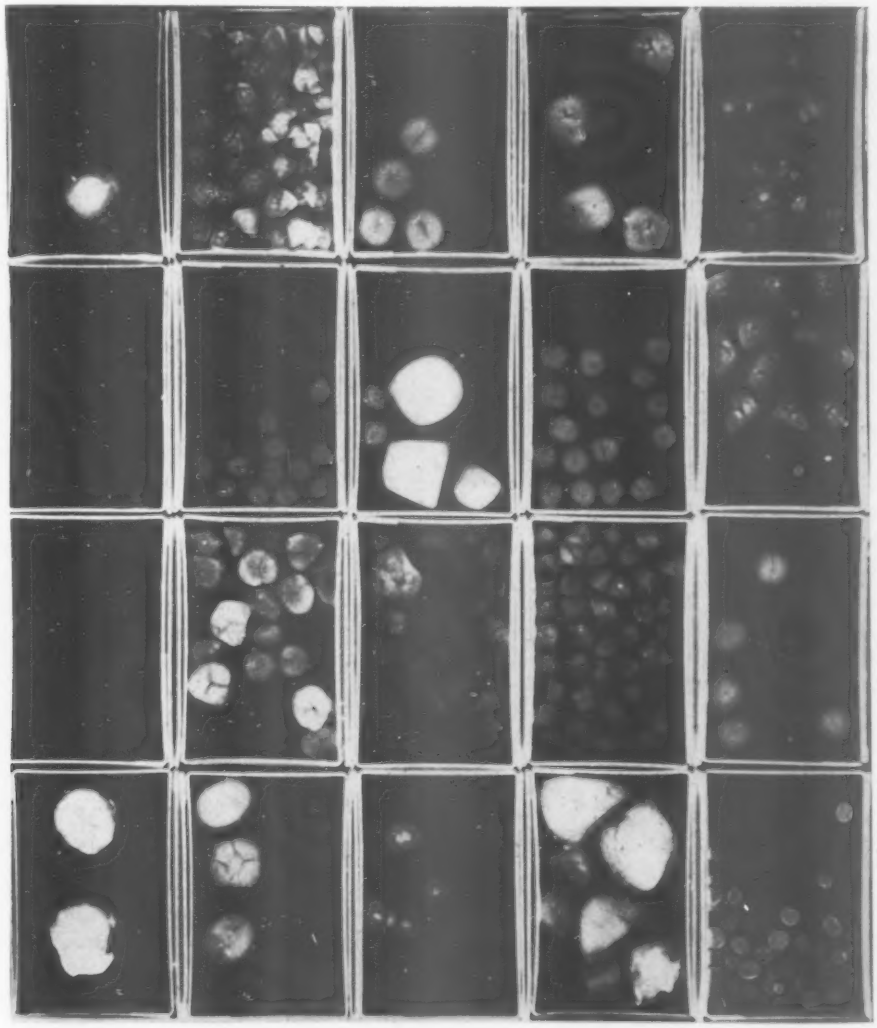

Fig. 4. Roentgenogram of 20 boxes of dried biliary calculi. These are the selected positive cases showing fissures in a survey of 150 such boxes. The calculi in Figure 2*A* are not included. There are literally hundreds of fissured calculi in this collection.

The apparent variation in density is an illusion. This is a single roentgenogram at low kilovoltage and the large calculi appear dense while many of the smaller ones are "blacked out" in reproduction. There are no actually dense calculi in the fissured collection.

Central fissuring does not occur in other calculi within the human body, suggesting

that the phenomenon is related to the peculiar composition, crystalline arrangement, environment of hypertonic bile or possibly all three.

The closest parallel to the fissuring within calculi which we have been able to find are the typical "shrinkage cracks" which occur in spot welding. Such central star-shaped and dendritic voids are demonstrated roentgenologically in the so-called "weld nugget." In metallurgical work it has been

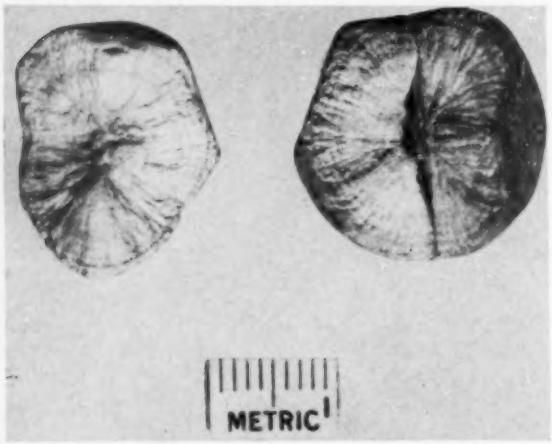

Fig. 5. Split calculus showing crystalline structure, concentric rings and central fissure. Photograph ×1.5.

found that central porosity and shrinkage cracks increase if solidification takes place rapidly. The roentgenograms of aluminum spot welds as shown by Smith and Keller[13] are almost identical with those in the biliary calculi we have studied. It seems to us highly probable that the fissures in gallstones represent a physical phenomenon resulting from rapid crystalline deposition in the form of calculi, followed by further solidification of the periphery and contraction and progressive dehydration of the central portion. The grossly radial structure of the cholesterol calculi in our case, which is clearly visible in Figure 5 favors the development of the dendritic crevasses leading from the center to the periphery. Such crystal arrangement is characteristic of cholesterol-rich calculi which are thought to be formed by rapid precipitation.[11]

The question of the origin of the gas within the fissures is still entirely problematical, but it is a well accepted physical principle that gases diffuse more readily than fluids through crystalloid and colloid matter.[12] It seems to the author that the development of low pressure voids or fissures within the calculi would favor the inward diffusion of whatever gases are dissolved in the bile bathing the calculi. No doubt the voids often form and are filled with fluid, as differential gaseous diffusion is evidently relatively uncommon and dependent upon the porosity of the crystals forming the calculus.

SUMMARY

Central fissuring occurs in certain gallstones in vivo. It is readily observed roentgenologically in stored dried calculi. We have observed this in 13.3 per cent of 150 boxes of dried gallstones, being most common in the non-opaque, cholesterol-rich variety. When the central fissures contain gas, it is possible to make a roentgenological diagnosis of cholelithiasis even though the calculi are non-opaque and the gallbladder cannot be visualized on cholecystography.

It is suggested that the fissures occur as a result of physical phenomena and that the gas finds it way into the central voids by diffusion.

George F. Geisinger Memorial Hospital and Clinic
Danville, Penna.

REFERENCES

1. Åkerlund, Å. Über transparente gashaltige Spaltbildungen in Gallensteinen und ihre röntgendiagnostische Bedeutung. *Acta radiol.*, 1938, *19*, 215–229.
2. Andrews, E., and Henry, Lucy Dell. Bacteriology of normal and diseased gallbladders. *Arch. Int. Med.*, 1935, *56*, 1171–1188.
3. Bauer, K. H. Über Selbstzerstrümmerung von Gallensteinen und Neubildung von Steinen auf der Grundlage von Steintrümmern. *Arch. f. klin. Chir.*, 1931, *165*, 53–80.
4. Breuer, Bela. Ueber ein neues Röntgensymptom der Gallensteinkrankheit. *Röntgenpraxis*, 1931, *3*, 879–881.
5. Broden, B. On occurrence of gas in gallstones. *Acta radiol.*, 1942, *23*, 413–419.

6. Delario, A. J. Gall stones. *Am. J. Digest. Dis. & Nutrition*, 1935, *2*, 511–520.
7. Kommerell, B., and Wolpers, C. Gashaltige Gallensteine. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1938, *58*, 156–174.
8. Ortmayer, M., and Connelley, M. Star-shaped radiolucencies of gallstones; rare roentgen sign. *Radiology*, 1942, *38*, 39–42.
9. Patey, D. H. Modern views on mechanism of gall-stone formation. *Brit. M. J.*, 1933, *1*, 866.
10. Phemister, D. B., Aronsohn, H. G., and Pepinsky, R. Variation in cholesterol, bile pigment and calcium salts contents of gallstones formed in gallbladder and in bile ducts with degree of associated obstruction. *Ann. Surg.*, 1939, *109*, 161–168.
11. Shade, H. In: Concretions in Colloidal Chemistry. Edited by Alexander. Little, Brown & Company, Boston, 1928, II, 803.
12. Sidhu, S. S. Department of Physics, University of Pittsburgh Medical School. Personal communication.
13. Smith, D. W., and Keller, F. Correlation of metallographic and radiographic examination of spot welds in aluminum alloys. *Industrial Radiography*, April, 1943.

ANOMALIES OF THE LUMBOSACRAL VERTEBRAE IN FIVE HUNDRED AND FIFTY INDIVIDUALS WITHOUT SYMPTOMS REFERABLE TO THE LOW BACK*

By JOHN D. SOUTHWORTH, M.D., *and* SOLOMON R. BERSACK, M.D.
WASHINGTON, D. C.

THE relationship of low vertebral anomalies to symptomatology is becoming progressively more important. Compensation cases developing from injury or disease of the lumbosacral vertebrae often become involved with the question whether anomalies of this region are factors in the production of symptoms. With the return of over ten million individuals from the armed forces to civilian life the question of what role anomalies play in producing symptoms will arise with increasing frequency. Because this question is constantly confronting us in our Veterans Hospital, we have made the following study in order to determine the normal incidence of low vertebral anomalies. In this communication we are reporting a study of 550 normal individuals, that is, individuals without symptoms referable to the low back region.

From a survey of the voluminous literature much pertinent information has been gleaned. The authors report varying incidence of the several anomalies. These differences may be reconciled when one analyzes the series as to the selection of material, the mode of study and the definition of terminology as well as the degree of anomalous deviation requisite for inclusion as a positive anomaly. Much more striking than the differences in the statistical incidence are the variations in the clinical significance attached to these vertebral anomalies. The importance attributed to anomalies in the production of symptomatology runs practically the whole gamut—from cautious minimal to uncritical maximal. Pugh (quoted by Brailsford[1]) found 85 per cent of the backs to have some deformity. He therefore expressed the opinion that the majority have no clinical significance. Contrasted with this is the attitude of Dittrich[2] who attributed "muscular rheumatism, low back pain, spastic paralysis, hematogenous osteomyelitis, enuresis, dysmenorrhea and constipation" to even "minimal sacral spina bifida occulta" and the "uniformly associated pathologic masses of soft tissue, fat, fibrous tissue and muscle." In a reflective mood one may succinctly enumerate with Willis[12] the many disease entities which at one time or another were incriminated in low back pain. "In the campaign against low back pain and sciatica one recalls the battles of gynecology, sacroiliac subluxation, postural fault, congenital anomalies, fascitis and contractures, spastic pyriformis, displaced intervertebral discs, thickened ligamenta flava and narrowed intervertebral spaces." Today ruptured intervertebral discs and congenital anomalies are in vogue.

Prerequisite for the understanding and evaluation of the congenital anomalies is the crucial concept of transition. One must consider the transition aspect both phylogenetically and regionally along the junctions of the several segments of the spine —cervicothoracic, thoracolumbar and lumbosacral. Phylogenetically from the primitive mammal to man, comparative studies have established the evolutionary diminution of the number of vertebrae cephalad to the sacrum. Regionally at the lumbosacral

* From the Department of Radiology, Mt. Alto Veterans Hospital, Washington, D. C. Published with the permission of the Chief Medical Director, Department of Medicine and Surgery, Veterans Administration, who assumes no responsibility for the opinions expressed or conclusions drawn by the authors.

junction the trend toward greater stability by inclusion in the sacrum of the last lumbar vertebra has been discerned. Predicated upon such transition factors one would expect frequent occurrence of anomalies. The clinical significance of such anomalies can best be adjudged by statistical correlation with the normal incidence in asymptomatic persons.

MATERIAL

This study consists of the review of 550 of our upper gastrointestinal examinations over the past three years. Any case on which bone and joint examinations had been made was discarded. The supposition is that the remaining cases were free from symptoms referable to their skeletal system. They certainly were not disabled because of low vertebral disease. This supposition is deemed justified since roentgenography was freely resorted to in the investigation of every complaint. An analogous study was reported by Giles.[5] This author reviewed the roentgenograms of 1,122 negative urographic examinations. Our material, which comprises patients whose symptoms led to examination of the upper gastrointestinal tract, is even freer from confusion with symptoms referable to the low back. Rivers and Roodenburg[10] mention cancer of the rectosigmoid, diverticular abscess and direct spine metastases as the only forms of gastrointestinal disease which may result in back pain referred to the lumbosacral region.

The six hour films of the 550 cases were carefully reviewed. On the last 300 cases the six hour films were taken purposely in the anteroposterior projection so as to minimize the distortion of the lumbosacral vertebrae. All the roentgenograms were analyzed with respect to the following normal variations, anomalies and derangements: Size of the transverse processes of L3 to L5, plane and symmetry of the articular facets, spina bifida occulta, sacralization, lumbarization, lumbar ribs, scoliosis and arthritis.

ANALYSIS

A. *Size of the Transverse Processes.* The configuration and size of the lumbar transverse processes are sufficiently varied so that they are often utilized as identifying landmarks in cases where the proper labeling of films is being questioned. This variability renders it difficult to determine whether enlargement of transverse processes of L5 exists. The desirability for establishing the modal average of the transverse processes was expressed by Willis.[11] He found that "simple enlargement

Fig. 1. Method of measuring roentgenographic "length" and "width" of transverse processes. The "length" comprises the roentgenographic anteroposterior projection measured between the midpoint on the medial aspect of the pedicle and the midpoint at the lateral tip of the transverse process. The "width" comprises the largest dimension perpendicular to the long axis. (Neg. No. 257, Veterans Hospital, Washington, D. C., retouched)

TABLE I

ROENTGENOGRAPHIC LENGTH AND WIDTH (IN MM.) OF THE TRANSVERSE PROCESSES OF L3, L4 AND L5

Vertebra		Average		Median		Mode		Minimum		Maximum		Only 5 per cent will be				Only 15 per cent will be			
												Above		Below		Above		Below	
		Rt	Lt	Rt	Lt	Rt	Lt	Rt	Lt	Rt	Lt	Rt	Lt	Rt	Lt	Rt	Lt	Rt	Lt
L3	Length	38	39	37.5	38.5	40	39	28	29	50	53	45	49	31	31	42	44.5	33	34
	Width	13	13	12.5	13.5	14	14	7	9	18	19	16	16	11	11	15	15.5	11.5	11.5
L4	Length	34.5	36	34.5	35.5	35	33	24	25	49	48	43	44.5	27.5	29	39.5	41	30.5	32
	Width	11	12	10.5	11.5	11	11	8	8	18	18	14	14.5	9	10	12.5	13.5	10.5	10.5
L5	Length	36	36.5	35	36.5	35	35	27	27	45	50	42	42	31	31	40	40	32	33
	Width	16	16	15.5	16.5	16	18	9	9	23	35	20	21	11	11	18	19	13	13

or decrease in size of the transverse process of the last lumbar without impingement or articulation with the sacrum or ilium is a less marked indication of numerical variation in the total number of presacral vertebrae. But until a modal type of last lumbar transverse processes has been determined such evidence cannot be evaluated," since one cannot definitely tell whether the enlarged transverse process should be counted as an indication of a sacral feature.

In an attempt to arrive at the average dimensions we measured the transverse processes of L4 and L5 in the 300 cases on whom anteroposterior six hour films were available. On 100 of these, the transverse processes of L3 were also measured for comparison. Since the medial limit of the transverse processes cannot be determined on the roentgenogram we took the medial border of the pedicles as a landmark. The "length" that we measured, therefore, comprises the roentgenographic anteroposterior projection measured between the midpoint on the medial aspect of the pedicle and the midpoint at the lateral tip of the transverse process (Fig. 1). The "width" comprises the largest dimension perpendicular to the long axis. This would include the accessory process (anapophysis), the rudimentary true transverse process which occasionally projects more prominently on the inferior aspect of the base of the transverse process. Anatomically the lumbar transverse processes are homologous with the ribs and hence they are sometimes called the costal processes. Behind the base of each transverse or costal process is a small eminence directed downward which cor-

TABLE II

RELATIVE ROENTGENOGRAPHIC LENGTH AND WIDTH OF THE TRANSVERSE PROCESS OF L4 WITH RESPECT TO THE PROCESSES OF L3 AND L5 IN THE SAME INDIVIDUAL

Transverse Processes of L4				Corresponding Side of Transverse Process								Per Cent of Cases
				in respect to length				in respect to width				
right	and	left	smaller than	L3	and	L5	and	L3	and	L5		21
right	and	left	smaller than	L3	and	L5	and	L3	and	L5		43
right	and	left	smaller than	L3			and			L5		4
right	or	left	smaller than					L3	and	L5		9
right	and	left	smaller than							L5		12
			others									11

responds with the transverse processes of the thoracic vertebrae. It is named the accessory process or anapophysis.[8] Table 1 summarizes the results of these measurements.

the right or left transverse process of L_4 exhibited this upward direction while the corresponding process of L_3 was horizontal or downward. No cases were found with both processes of the L_3 having an upward

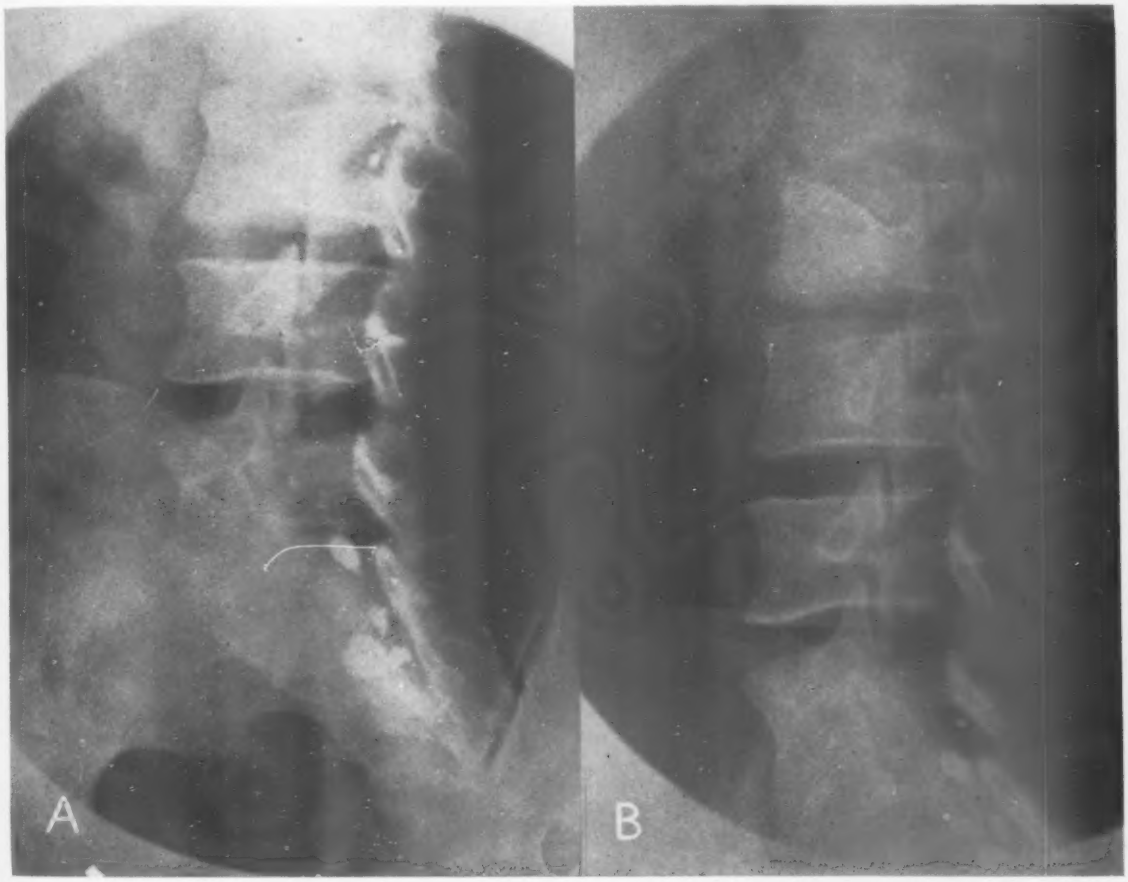

Fig. 2. (*A*) Apparent narrowing of the left posterior articulating space of L_4–L_5 produced by the curvature of the facet. (*B*) Additional view taken in another degree of obliquity depicts a normal space when the predominant plane of articulation is projected en face.

Table 11 shows the relative length and width of the processes of L_4 with respect to the processes of L_3 and L_5 in the same individual. In only 3 per cent were both the right and left processes of L_4 larger in width and length than both the corresponding processes of L_3. In 43 per cent of 100 cases selected at random the right and left transverse processes of L_4 showed an upward direction whereas both corresponding processes of L_3 showed a horizontal or downward direction. In 37 per cent either

direction in which the corresponding processes of L_4 had a horizontal or downward course.

B. *Plane and Symmetry of Articular Facets.* Typically the plane of the articular facets of the cervical vertebrae is horizontal, oblique in the thoracic, sagittal in the lumbar segment and coronal at the lumbosacral junction. Pheasant and Swenson[9] pointed out the important fact that "facets (which on roentgenograms appeared to be oblique) were actually curved. As a matter of fact,

no facet plane is purely oblique, sagittal or coronal, but all have some curved component, corresponding to a segment of a cylinder, either completely or in part. These facets may appear on the roentgenograms as sagittal or coronal, depending upon which component is predominant." Furthermore, because of this curvature it is hazardous to diagnose narrowing of the posterior articular (apophyseal) space upon the basis of an anteroposterior and single oblique view, unless the narrowing is of marked degree. Figure 2 is an example of such a case. At another hospital narrowing of the left articular space of L4–L5 was diagnosed. The anteroposterior and oblique views (Fig. 2*A*) seemed to substantiate this impression. However, additional views taken in varying degrees of obliquity (Fig. 2*B*) show that the narrowing is only apparent, since a normal space is depicted when the predominant plane of articulation is projected en face. It is these predominant planes of posterior articulations as shown on the six hour films which we recorded and analyzed as to symmetry. Of 215 L4–L5 articulations 158 (73.5 per cent) were symmetrical and 57 (26.5 per cent) were asymmetrical; i.e., one side had a coronal and the other an oblique or sagittal plane. Among the 158 symmetrical cases only 30 (19 per cent) could be definitely classified as sagittal, 34 (21.5 per cent) exhibited an oblique component, the remainder (94 = 59.5 per cent) may be presumed to be roentgenographically of the coronal type. Of 196 L5–S1 articulations 162 (82.6 per cent) were symmetrical and 34 (17.4 per cent) were asymmetrical. Among the 162 symmetrical cases only 11 (6.8 per cent) could be definitely classified as sagittal. Six (3.7 per cent) exhibited an oblique component, and the remainder 145 (89.5 per cent) may be presumed to be roentgenographically as of the coronal type. When the articulations of L4–L5 and L5–S1 were considered together, then 63.6 per cent were found to be symmetrical at both levels, whereas 36.4 per cent showed asymmetry either at L4-L5 or L5–S1 level.

Table III

Incidence of spina bifida in 550 cases without symptoms referable to low back

Vertebra	Degree of Defect					Total Number of Cases	Per Cent
	+	++	+++	++++			
L2	1					1	0.18
L4	1					2	0.36
L5	3	2				5	0.9
L5/& S1					1+/2+; 1+/2+; 1+/3+	3	0.54
L6	1					1	0.18
L6/& S1					2+/2+	1	0.18
S1	30	27	12	5		74	13.5
S1/& S2		2	2			4	0.72
S1 to S5						6	1.1

C. *Spina Bifida Occulta.* The reported incidence of spina bifida occulta in the lumbar vertebrae varies from 0.2 per cent in Hadley's[6] series to 6 per cent of the 5th lumbar in Brailsford's[1] study. In the sacral segment the discrepancy found in the literature ranges from 5 per cent in Hadley's report to 34 per cent in Friedman, Fischer and VanDemark's[4] small series of 100.

In our material of 550 patients we found exactly 100 cases, or 18.2 per cent, with spina bifida. This included 12 lumbar (2.2 per cent) and 88 sacral (16.0 per cent). The defects in the neural arch were further analyzed as to extent and location in relation to midline. They were designated as

central, right, left or bilateral—when the defect was in the laminae on either side of a well developed spine. Of the lumbar defects only 1 was to the left of the midline. Of the sacral defects only 3 were to the right, 2 to the left of the midline and 1 bilateral. The vast majority of the defects were central in location. The extent was expressed as (+) when the transverse diameter of the projected defect on the anteroposterior six hour film measured less than 0.5 cm.; as (++) when between 0.5 and 1.0 cm.; as (+++) between 1.0 and 1.5 cm. and (++++) when more than 1.5 cm. Table III summarizes our findings.

D. *Sacralization.* Thirty-five patients (6.4 per cent) were found to have sacralization of the last lumbar vertebra. These patients exhibited a last lumbar vertebra situated higher than the usual level of the first sacral in relation to the iliac crests. The transverse processes were markedly overdeveloped and wing-shaped. They were designated as complete sacralization when the inferior border of the transverse process appeared in the anteroposterior projection to be contiguous and articulating with the homologous segment of the first sacral vertebra. Incomplete sacralization signifies non-contiguity of these homologous segments. Of the 35 cases, 19 were of the complete and 16 of the incomplete variety. In addition, 4 patients showed grossly enlarged transverse processes of L_5 but without any tendency toward wing-shaped configuration. The details of distribution are listed below in tabular form.

E. *Lumbarization.* Eleven (2 per cent) patients were found to have lumbarization of the first sacral vertebra. These patients exhibited a first sacral vertebra situated lower than the usual level of the last lumbar

TABLE IV

INCIDENCE OF SACRALIZATION AND LUMBARIZATION AND THEIR ASSOCIATION WITH SCOLIOSIS AND ARTHRITIS

	Number of Cases	Bony Sclerosis at Junction of Transverse Process with Sacrum		Lumbar Scoliosis		Lumbar Arthritis	
		No. of cases	Per cent	No.	Per cent	No. of cases	Per cent
SACRALIZATION Total:	35	8	22.8	10	28.5	30–39 yr. 40 yr. and over	10 50.7
Complete bilateral symmetrical	6	0		4		1	
Complete bilateral asymmetrical	4	2		1		1	
Complete unilateral	9	3		4		2	
Incomplete bilateral symmetrical	6	0		0		1	
Complete on one side, incomplete on other side; asymmetrical	5	3		0		0	
Incomplete unilateral	5	0		1		0	
LUMBARIZATION Total:	11	2		0		3	
Symmetrical	3	0		0		1	
Asymmetrical	3	2		0		0	
Unilateral	5	—		0		2	

TABLE V

INCIDENCE OF ARTHRITIS AND SCOLIOSIS IN 300 PATIENTS WITHOUT SYMPTOMS REFERABLE TO THE LOW BACK

Age Groups	Arthritis			Arthritis and Scoliosis				Scoliosis		
	Degree	No. of cases	Per cent	Degree	No. of cases	Per cent	Degree	Degree	No. of cases	Per cent
Under 30 years	+	2		+	1		+	Min.	12	9.0
								+	13	9.6
								++	2	1.5
Total		2	1.5		1	0.07			27	20.1
No. of patients 135										
30 to 39 years	Min.	4	4.1	Min.	1	1	Min.	Min.	9	9.2
	+	3	3.1	Min.	1	1	+	+	9	9.2
				+	1	1	+	++	1	1
								+++	1	1
		7	7.2		3	3			20	20.4
Total No. of patients 98	Incidence in nonscoliotic group 9.3%			Incidence in scoliotic group 13%						
40 years and over	Min.	8	12.0	Min.	1	1.5	Min.	Min.	1	1.5
	+	11	16.4	Min.	2	3.0	++	+	2	3.0
	++	4	6.0	+	2	3.0	Min.	++	1	1.5
	++++	2	3.0	+	2	3.0	+	+++	2	3.0
				+	1	1.5	++			
				+	1	1.5	+++			
		25	37.4		9	13.5			6	9.0
Total No. of patients 67	Incidence in nonscoliotic group 48.1%			Incidence in scoliotic group 60.0%						

in relation to the iliac crests. The portion of the ala of sacrum homologous to the transverse process formed or tended to form either a completely or incompletely separate segment. Of the 11 cases 5 were unilateral and 6 were bilateral. Four of the 5 unilateral cases showed a completely separate transverse process. Table IV summarizes these findings in the transitional vertebrae in relation to age distribution, presence of an articular joint at junction of the transverse process and sacrum, bony sclerosis at these articulating margins, lumbar scoliosis and lumbar arthritis.

F. *Lumbar Ribs.* Thirty-four (11.3 per cent) out of 300 individuals had first lumbar ribs. In 25 instances they were bilateral, in 4 on the right and in 5 on the left only. This anomaly is evidently without any clinical significance. According to Keith (quoted by Willis[11]) about 2 per cent of vertebral bodies show the 19th (12th thoracic) segment without ribs, and in 6 to 8 per cent the 20th (1st lumbar) carry ribs. This must be kept in mind when speaking of six lumbar vertebrae without an actual count of all presacral vertebrae.

G. *Scoliosis and Arthritis.* The degree of scoliosis and arthritis was expressed as minimal, one plus up to four plus. Both rotatory and lateral scoliosis were included. The extent of the arthritic process was judged by the bony hypertrophic or sclerotic changes visible at the vertebral margins

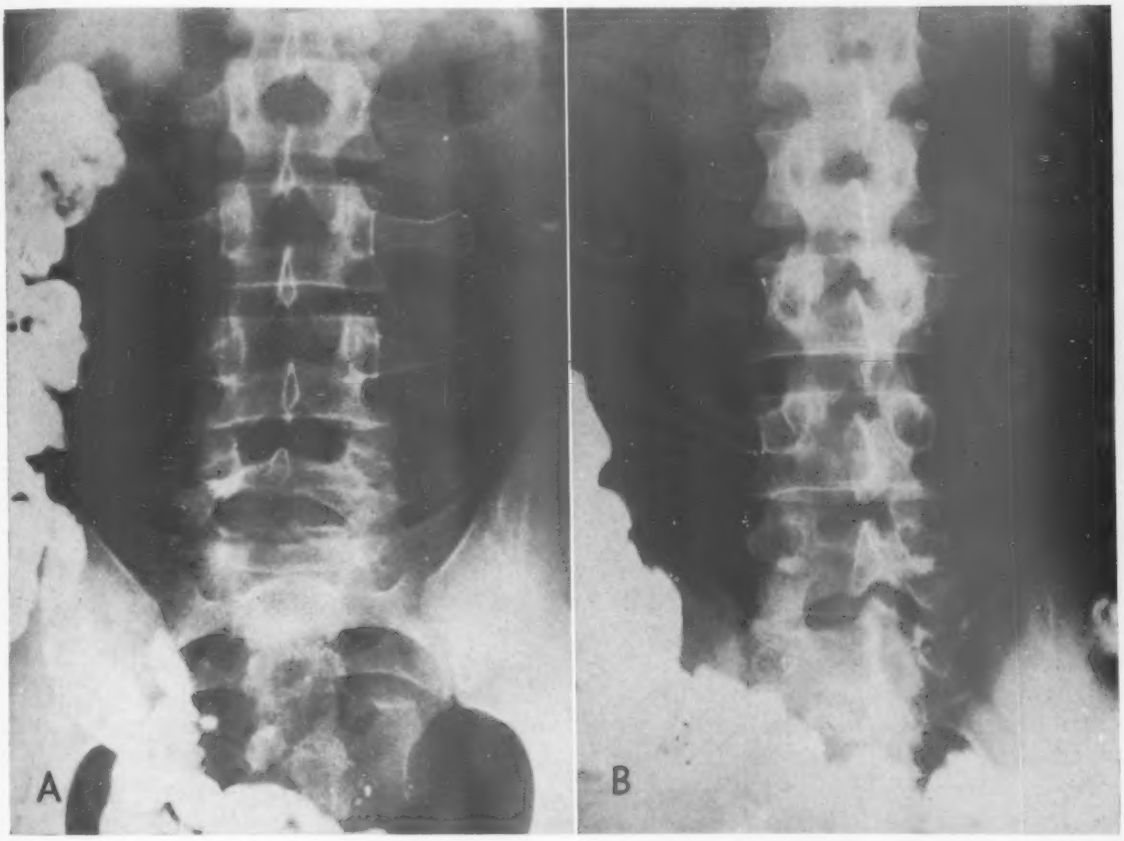

Fig. 3. (*A*) Identification of the fourth lumbar transverse process by one or more of the following features: (1) it is shorter and narrower; (2) it has an upward inclination (left); (3) its inferior border is inclined upward (right). (*B*) The lateral half of the inferior border has a sharp cephalad inclination. Even in those few cases in which the process of L_3 is also directed upward, that of L_4 has a sharper upward angulation or its inferior border has a cephalad inclination throughout its extent or in its lateral half—as illustrated here. (*A* and *B* retouched.)

and apophyseal articulations. Table v gives the distributions as to age and degree of involvement. Out of 300 cases 66 showed scoliosis and 47 had arthritis. In 13 of these, scoliosis was associated with arthritis. The vast majority of the scoliotics and arthritics fell into the minimal and one plus group. Only 7 two plus, 4 three plus scoliotics, and 4 two plus and 2 four plus arthritics were encountered in the entire group. These 6 more severe cases of arthritis occurred in the older age group.

DISCUSSION

The modal dimensions of the transverse processes of L_4 and L_5 may be read from Table I. If one eliminates the extreme 15 per cent at either end then the roentgenographic width of the transverse processes of L_4 will range between 10.5 and 13 mm. and that of L_5 between 13 and 18.5 mm. Values of width of L_5 processes above 19 mm. should be presumed as evidence of an attempt at sacralization—even though there is no tendency toward wing-shaped configuration nor any articulation or contiguity with the sacrum. The values for the width appear to be a more reliable criterion than the corresponding values (32 to 40 mm.) for the length of the processes of L_5. In individuals with large bone dimensions a ratio of the width of L_5 to L_4 process greater than 19:13 (equal to 1.46) may be similarly taken as evidence of sacralization.

In addition to the fact that it is shorter and narrower, the configuration of the transverse process of L_4 helps to identify it.

It is usually directed upward, whereas that of L_3 is usually horizontal or downward. Even in those few cases in which the process of L_3 is also directed upward, that of L_4 has a sharper upward angulation or its inferior border has a cephalad inclination throughout its extent or in its lateral half (Fig. 3). These criteria aid in the identification of the fourth lumbar vertebra. In cases of transition vertebrae at the lumbosacral junction, one may, on the basis of these features, judge whether the next vertebra craniad partakes of the transition features either unilaterally or bilaterally.

All authors are agreed that symmetrical lumbar articular facets in the sagittal plane are good mechanically. Ferguson[3] is of the opinion that internal-external facets (sagittal) at the lumbosacral junction are good, anterior-posterior (coronal) are weak and may produce pain, and the mixed (asymmetrical) produce symptoms in practically every person when the asymmetry is of severe degree, i.e. one facet is of the sagittal and the other is of the coronal type. According to Brailsford[1] "a careful examination of all the radiographs of more than three thousand patients suggests that 57 per cent of the superior sacral articular facets face backwards, 12 per cent inwards and 31 per cent are mixed—that is, one side may face backward and the other inwards; one may be vertical, the other oblique. In only three of the cases in his series was a clinical deformity explained solely by an abnormal development of the articular surfaces. In these cases the superior articular facets were small and irregular, while the inferior facets and laminae of the vertebra above showed abnormal development which resulted in scoliosis. Asymmetry of the articular facets may be due to any lesion producing scoliosis." Howard[7] pointed out that "in the case of asymmetrical lateral articulation, the question is whether or not the type on one side can work freely and smoothly with the type on the other side. Often this is mechanically impossible." One may readily agree with Howard that the mixed type of articulations are mechanically undesirable. And yet, in spite of the consideration that theoretically these asymmetrical articulations "could not" and "should not" work—the fact is that a substantial number of individuals are born with asymmetrical articulation and they do function satisfactorily without any disabling symptoms. Fifty-four out of 233 patients under the age of forty definitely had asymmetrical posterior articulations either at L_4–L_5, L_5–S_1 or at both levels. No one of these 54 patients had scoliosis or arthritis; no one was disabled because of it or offered symptoms referable to the low back.

Many authors attributed the symptoms of low back pain to spina bifida occulta and presented several explanations. Thus Dittrich[2] thought that the modus operandi is through the "uniformly associated intraspinal pathologic changes which are much more profound in their effects than those which may be attributed to the bony defects. These consisted of masses of soft tissue, fat, fibrous tissue and muscle deposited around the nerve roots so as to produce compression of the nerves." Few authors, if any, would concur in such a sweeping incrimination of supposedly pathologic soft tissue masses. The absence of an external meningeal sac and the very low incidence of external manifestations, such as a dimple or hypertrichosis (only 4 per cent), militate against any significant intraspinal changes. Hadley[6] conceded that many defects appeared to be harmless but concluded that "this abnormality must be considered a factor for potential trouble. The defect which encroaches upon the lamina and may involve the inferior articular processes must, therefore, cause a loss in the stability of the vertebral column, both from the loss of articular surface and from lack of bone surface to which important muscles and ligaments are usually attached. Stability may also be affected by the change in ligamentous attachment, especially the interspinous ligaments which lack the anchorage of the spinous process." Such considerations would obtain only in very large defects, which are extremely rare. Furthermore, according to Howard,[7]

"when these defects are large they rarely cause pain; when narrow or irregular they may cause some discomfort, if a portion of the cauda is bound down by adhesions to the membranes, and if the membranes are caught in a fold of the ligamentum flavum." Howard hastened to add that this latter condition is extremely infrequent.

Our finding of 16 per cent incidence of spina bifida occulta in the sacral and 2.2 per cent in the lumbar vertebrae in asymptomatic persons indicates that the above quoted possible causes for backache are not valid in the vast majority of cases. We found no increase in the incidence of scoliosis or arthritis in patients with spina bifida occulta. We therefore feel justified in concluding that spina bifida occulta of the lumbosacral vertebrae is asymptomatic in the vast majority of individuals.

In addition to the evolutionary phylogenetic manifestations of transition, there are ontogenetic reasons for the occurrence of transition vertebrae at the lumbosacral junction. The first sacral segment of the vertebral column is determined by the level at which the ilia articulate with the spinal column to form the sacroiliac joints. These joints are formed not by vacuolation in the mesodermal tissues, as are most joints, but by the approach of the ilia, developing in the limb buds, to conjugate with the vertebrae. The meeting is usually, but not always, bilaterally symmetrical. Lagging of one ilium behind the other results in asymmetrical sacralization of the last lumbar or lumbarization of the first sacral (Willis[13]). Brailsford and Hadley, as well as Willis, subscribed to the thesis that asymmetrical sacralization is symptomatic. The former concluded that the most frequent deformity associated with a developmental irregularity is the scoliosis due to asymmetrical sacralization of the fifth lumbar transverse process and that the developmental irregularities which alter the alinement of the vertebrae tend to become more pronounced with age. Hadley[6] found a higher incidence of arthritis (14.88 per cent as against 7.03 per cent) and of acquired defects such as scoliosis, lordosis and kyphosis (10.72 per cent as against 4.52 per cent). Ferguson[3] was of the opinion that pain is frequent in cases of sacralization where there is motion at the contiguous surfaces.

The analysis of our material forces us to a contradictory opinion. As Table v clearly shows the incidence of lumbar scoliosis bears no relation to age. Its incidence is approximately 22 per cent in persons under thirty as well as in persons 40 years and over. Lumbar arthritis has its major relationship with age and only a minor one with scoliosis. We found lumbar arthritis in 1.9 per cent of patients under thirty years; in 9.3 per cent between thirty and thirty-nine years and in 48.1 per cent in persons forty years and over in the non-scoliotics —as against 3.6 per cent, 13.0 per cent and 60.0 per cent in the scoliotic group for the respective age brackets.

Table iv brings out the lack of any increase in lumbar arthritis with sacralization. The frequency in the thirty to thirty-nine year olds (10 per cent) is identical with that in the total group; and in the forty year age group and over it is even smaller (33.3 per cent) than in the group as a whole (50.7 per cent). Scoliosis shows only a slight increase—from 22 per cent to 28.5 per cent. The degree of scoliosis was either only one or two plus. However, there was a rather frequent occurrence of some bony sclerosis at the contiguous margins of the transverse process of L5 and sacrum (22.8 per cent). But even these patients as well as the group with arthritis and scoliosis offered no complaints referable to the low back. Similarly the patients with lumbarization were asymptomatic.

SUMMARY AND CONCLUSIONS

1. The six hour films of 550 patients, on whom upper gastrointestinal examinations had been performed, were reviewed. No case in which bone or joint examination had been made was included. In view of the fact that roentgenography was freely resorted to in the investigation of every complaint, it is deemed justifiable to suppose that the 550 patients were not dis-

abled because of low vertebral disease.

2. The terms roentgenographic length and width of the transverse processes of L4 and L5 were defined and their modal dimensions were established.

3. Values of roentgenographic width of the L5 transverse process above 19 mm. should be presumed as evidence of an attempt at sacralization—even though there is no tendency toward wing-shaped configuration nor any articulation or contiguity with the sacrum.

4. The transverse process of the fourth lumbar may be identified by one or more of its characteristics. It is shorter, narrower, directed upward, has a sharper upward angulation or an inferior border with a craniad inclination, whereas that of L3 is longer and directed horizontally or downward. In cases of transition vertebrae at the lumbosacral junction one may, on the basis of these features, judge whether the next vertebra craniad partakes of the transition features either unilaterally or bilaterally.

5. In spite of the consideration that theoretically asymmetrical posterior (apophyseal) articulations "could not" and "should not" work, the fact is that a substantial number of persons are born with asymmetrical articulations and they do function satisfactorily. Fifty-four out of 233 patients under the age of forty definitely had asymmetrical posterior articulations either at L4–L5, L5–S1 or at both levels. No one of these 54 patients had scoliosis or arthritis; no one was disabled because of it or offered symptoms referable to the low back.

6. Our finding of 16 per cent incidence of spina bifida occulta in the sacral and 2.2 per cent in the lumbar vertebrae without any increase in frequency of scoliosis or arthritis indicates that this anomaly is asymptomatic in the vast majority of individuals.

7. The analysis of our material forces us to a conclusion contradictory to the opinion held by most authors regarding sacralization. We found no increase in lumbar arthritis in both symmetrical and asymmetrical sacralization. Lumbar arthritis has its major relationship with age and only a minor one with scoliosis. In addition to a slight increase in scoliosis (from 22 per cent to 28.5 per cent) there was a rather frequent occurrence of bony sclerosis at the contiguous margins of the transverse processes of L5 and sacrum (22.8 per cent). But even these patients as well as the group with arthritis and scoliosis offered no complaints referable to the low back.

Mt. Alto Veterans Hospital
2650 Wisconsin Ave., N.W.
Washington 7, D. C.

REFERENCES

1. Brailsford, J. F. Deformities of lumbosacral region of spine. *Brit. J. Surg.*, 1929, *16*, 562–627.
2. Dittrich, R. J. Roentgenologic aspects of spina bifida occulta. Am. J. Roentgenol. & Rad. Therapy, 1938, *39*, 937–944.
3. Ferguson, A. B. Clinical and roentgenographic interpretation of lumbosacral anomalies. *Radiology*, 1934, *22*, 548–558.
4. Friedman, M. M., Fischer, F. J., and VanDemark, R. E. Lumbosacral roentgenograms of 100 soldiers; control study. Am. J. Roentgenol. & Rad. Therapy, 1946, *55*, 292–298.
5. Giles, R. G. Vertebral anomalies. *Radiology*, 1931, *17*, 1262–1266.
6. Hadley, H. G. Frequency of spina bifida. *Virginia M. Monthly*, 1941, *68*, 43–46.
7. Howard, L. G. Low back pain and lumbosacral joint. *M. Clin. North America*, 1942, *26*, 1551–1579.
8. Morris. Human Anatomy. Eighth edition. P. Blakiston's Sons & Company, Philadelphia, 1925, p. 92.
9. Pheasant, H. C., and Swenson, P. C. Lumbosacral region; correlation of roentgenographic and anatomical observations. *J. Bone & Joint Surg.*, 1942, *24*, 299–306.
10. Rivers, A. B., and Roodenburg, A. I. Back pain in disease of gastrointestinal and accessory gastrointestinal tract. *J.A.M.A.*, 1944, *125*, 421–426.
11. Willis, T. A. Analysis of vertebral anomalies. *Am. J. Surg.*, 1929, *6*, 163–168.
12. Willis, T. A. Anatomical variations and roentgenographic appearance of low back in relation to sciatic pain. *J. Bone & Joint Surg.*, 1941, *23*, 410–416.
13. Willis, T. A. Structure and development of spine. *J.A.M.A.*, 1944, *125*, 407–412.

Vol. 64, No. 4

PSORIATIC ARTHRITIS*

REPORT OF A CASE

By HENRY P. PLENK, M.S., M.D.†

SALT LAKE CITY, UTAH

THE term "psoriatic arthritis" is used in essentially three different conditions:

1. In patients with psoriasis who have joint pains without roentgen evidence of arthritis.

2. In patients with psoriasis who have roentgen evidence of rheumatoid arthritis. In some the two diseases appear to have no relationship to each other. In others a definite parallelism exists in the remissions and exacerbations of both diseases.

3. In patients with psoriasis who have arthritis limited to the terminal interphalangeal joints with associated psoriatic involvement of the respective fingernails.

A case of the latter type will be described and the entity of psoriatic arthritis discussed.

E. M., male, white, aged fifty-eight, salesman, entered the hospital on September 22, 1947, complaining of stomach and chest pain.

Present Illness. The patient has been treated for repeated exacerbations of a duodenal ulcer for the past fourteen years. He has had night distress for the past three months relieved by milk and food. For the preceding period of six months the patient has experienced a sharp pain over his precordium without radiation and unrelated to exertion.

Past History. For twenty-five years the patient has had psoriatic patches over his elbows, the anterior surfaces of the tibiae and knees, the scalp, back, buttocks and scrotum. For about fifteen years he has had painful fingers and toes. The fingernails, except for the left middle and right index finger, have been thickened and dead and he can "whittle them off." He states that a Sippy diet makes his "arthritis" worse.

At the age of eleven he had "inflammatory rheumatism" but after ninety days in bed no residues of joint disease remained. The patient has had no complaints referable to any joints other than the fingers.

Physical Examination. The patient was an alert well nourished white male in no acute distress. The significant findings were large red circinate scaly lesions of the skin over the knees, both legs anteriorly and posteriorly, both thighs, elbows, buttocks and the thorax. The nails of both hands except the left middle and the right index finger were thickened and scaly. The distal interphalangeal joints of the fingers with nail involvement presented flexion deformities (Fig. 1).

Laboratory Data. The blood serum, urine, and stool revealed nothing abnormal. Gastric acidity after injection of histamine was 87 total and 76 free units. The blood uric acid level was 2.7 mg. per 100 cc.

A skin biopsy through one of the psoriatic patches was diagnosed as chronic nonspecific dermatitis with slight parakeratosis and hypertrophy of the rete, compatible with psoriasis.

Roentgenograms of both hands revealed extensive arthritic changes of the distal interphalangeal joints, sparing only the left middle and the right index finger (Fig. 2). The joint cartilages had completely disappeared. The cortices were irregular and revealed sclerotic as well as punched out cystic changes at the articular margins. The other joints of the hands and wrists were not involved in the process.

Examination of the chest, lumbar spine, sacroiliac joints and both feet revealed no evidence of organic lesions. Gastrointestinal studies disclosed a typical ulcer deformity of the duodenum with a crater. The right maxillary antrum was under-aerated as the result of fluid or thickened membrane.

Course and Treatment. The patient was put on a routine ulcer management resulting in rapid improvement of his gastrointestinal complaints. Treatment of the skin lesions with crude coal tar followed by ultraviolet radiation was mildly successful.

* From the Department of Radiology, University of Utah Medical School and the Veterans Administration Hospital, Salt Lake City, Utah.

† Associate Professor of Radiology, University of Utah and Consultant in Radiology, Veterans Administration Hospital.

REVIEW OF LITERATURE

Incidence. The incidence of psoriasis in patients with rheumatoid arthritis has been found to vary from 1 to 7 per cent.[6] It was reported as 2.5 per cent by Dawson[4] and 4 per cent by Douthwaite.[5] Bauer *et al.*[2] found the incidence of psoriasis to be 2.7 per cent in 300 patients with rheumatoid arthritis but only 0.7 per cent in a similar number of non-arthritic controls.

fined to terminal interphalangeal joints. The nails of the involved digits showed psoriatic lesions. Of 23 patients with rheumatoid arthritis, 17 had psoriatic nail changes, 13 of whom had associated terminal phalangeal joint involvement.

About 200 cases of psoriatic arthritis have been reported in the literature up to 1939.[6]

Definition. Epstein[6] defines psoriatic ar-

FIG. 1. Psoriatic nail changes and flexion deformities sparing only the left middle and the right index finger

On the other hand, Tobias[16] found 8 per cent of an unspecified number of psoriatics suffering from various types of joint diseases. In 11, or 25 per cent, of Madden's[11] 44 cases with psoriasis, arthritis appeared at some time during the presence of skin manifestations. However, only 1 of these patients had simultaneous remissions and exacerbations of both diseases, while no direct relationship between the signs and symptoms of the two conditions existed in the remaining 10 patients. No mention as to the joints involved was made. O'Leary[7] found 8 cases of arthritis among 1,400 patients with psoriasis. Of 26 patients with psoriasis and arthritis reported by Bauer, Bennett and Zeller,[2] 3 had arthritis con-

thritis as occurring in cases with atrophic arthritis associated with psoriasis and exhibiting a reasonable amount of synchronous activity, evidenced by remissions and relapses of the articular and cutaneous manifestations. Jeghers and Robinson[9] define "true" arthritis psoriatica in similar terms, while Bauer, Bennett and Zeller[2] believe that the term should be limited to cases in which the arthritis is confined to the terminal phalanges.

Pathology. Bauer, Bennett and Zeller[2] found the synovial changes in knee joints of 6 patients with psoriasis and arthritis who also exhibited terminal phalangeal joint involvement similar to those known to exist in rheumatoid arthritis; i.e., chronic

Fig. 2. Right (*A*) and left (*B*) hand. Arthritic changes involve all distal interphalangeal joints except that of the left middle and right index finger.

synovitis with hypertrophied villi with hyperemia, inflammatory cell infiltration, focal collection of lymphocytes, often with germinal centers. In more advanced cases pannus formation, fibrous ankylosis, articular destruction and bony ankylosis or deformities were evident. Though none of the sections were taken through the interphalangeal joints the authors assume that the findings would be similar in these joints.

Joints were examined at postmortem on a sixty-eight year old patient with arthritis limited to the interphalangeal joints and whose complaints dated back to the age of twenty-four. Marked articular destruction and bone resorption had resulted in

pronounced marginal overgrowth of bone at the sites of tendon insertions and formation of cup-like deformities at the proximal ends of these bones. The authors remarked that despite the pronounced articular destruction, diffuse atrophy such as is expected in rheumatoid arthritis was not present. The terminal joint spaces were replaced by a dense cellular fibrous tissue in which inflammatory changes were absent or minimal.

This only indicates that the acute destructive process had died out and that the findings at postmortem were manifestations of the healing and repair processes which probably had been in the foreground for many years.[14]

Nordin[13] reported the case of a thirty-three year old white male with a history of psoriasis and arthritis of almost simultaneous onset and of nine years' duration. All the joints in the body produced arthritic symptoms and the parallelism of the remissions and exacerbations of the skin changes and joint pains was very striking. Roentgenograms revealed advanced destructive changes of the articular cortices of the bones of the wrist, the proximal and distal interphalangeal joints, the tarsus, knees and shoulders.

At postmortem examination the left elbow and left knee were the only joints examined. Nothing unusual was seen in the elbow. Pronounced destruction of the articular cartilage and proliferation and thickening of the synovia in the knee joint was identical with the changes found in rheumatoid arthritis.

The authors of both of these studies came to the conclusion that the pathological changes in the joints of patients with arthritis and psoriasis are usually indistinguishable from those of uncomplicated rheumatoid arthritis.

Roentgen Findings. Jeghers and Robinson[9] expressed the view that the roentgen changes in psoriatic arthritis are not characteristic of the disease. Narrowing of interarticular spaces, periarthritic swelling and bone atrophy are common in the early phase. Ankylosis is rare at the start but may occur later as the result of extensive destruction of the articular cartilage.

Adrian,[1] and Shlionsky and Blake[15] thought that the destruction of bone in psoriatic arthritis is incomparably greater than in the usual case of rheumatoid arthritis. However, the latter authors concluded that the destructive changes described in their case are not peculiar to the disease.

Hench *et al.*[8] have best summarized the situation in saying that "certain features of psoriatic arthritis are quite distinct. Except in one anatomic situation the appearance of psoriatic arthritis is quite that of mild or moderately advanced, only occasionally of severe, atrophic arthritis and is indistinguishable from it objectively and roentgenographically. The terminal joints of the fingers and toes are rarely involved in atrophic arthritis, as a rule only in the most severe cases and then only late." This involvement of the terminal interphalangeal joints appears to be the most characteristic feature of psoriatic arthritis.

DISCUSSION

A study of the literature does not supply a definite answer to the question: Is psoriatic arthritis a specific entity? No characteristic histopathologic features could be detected in the few pathologic studies of arthritic joints of patients with psoriasis. Inasmuch as synovia and bone react in the same manner to many noxae this is not surprising. With pathologic changes similar to other forms of arthritis the roentgen appearance cannot be expected to be characteristic. No doubt exists that even the most destructive changes do occur without associated psoriasis. Striking cases of advanced absorption and tapering of the bones of the forearm and metacarpals were reported by Shlionsky and Blake[15] and Jungman and Stern.[10] These were very similar to but no worse than the changes in patients without psoriasis described by Marie and Léri[12] and more recently by Crain[3] under the name of "opera-glass deformity" of the hand.

The diagnosis by roentgen ray can only be surmised when a patient presents himself with arthritis localized to the terminal interphalangeal joints, an unusual location in rheumatoid arthritis.

The interesting features in our case are the simultaneous involvement of the interphalangeal joints and the respective fingernails sparing one finger on each hand. In spite of the striking roentgen changes the patient preserved a good deal of motion in these joints and had almost normal use of his hands. No other joints were affected by arthritis.

SUMMARY AND CONCLUSION

1. A case of psoriasis and arthritis confined to eight terminal interphalangeal joints with concomitant psoriatic involvement of the corresponding fingernails is reported.

2. The roentgen findings are indistinguishable from those of rheumatoid arthritis except for the unusual location and the lack of involvement of any other joint.

3. The term "psoriatic arthritis" should be confined to arthritic changes of the terminal interphalangeal joints with associated psoriatic affection of the nail.

In a broader sense, cases of psoriasis with rheumatoid arthritis exhibiting striking correlation of remissions and exacerbations of the skin and joint manifestations may be included under this term. Psoriasis usually precedes the arthritis in these cases by months or years.

4. The reported pathological studies do not seem to lend any support to the idea of specificity of the arthritic lesions in psoriasis.

Salt Lake General Hospital
Salt Lake City, Utah

REFERENCES

1. Adrian. Quoted by Jungman and Stern.[10]
2. Bauer, W., Bennett, G. A., and Zeller, J. W. Pathology of joint lesions in patients with psoriasis and arthritis. *Tr. A. Am. Physicians*, 1941, *56*, 349–352.
3. Crain, D. C. Opera-glass hand (la main en lorgnette). *M. Ann. District of Columbia*, 1941, *10*, 293–296.
4. Dawson, M. H. Chronic arthritis. Nelson New Loose Leaf Med., 1946, *5*, 633–634.
5. Douthwaite, A. H. The Treatment of Rheumatoid Arthritis and Sciatica. Second edition. H. K. Lewis & Co., Ltd., London, 1933.
6. Epstein, E. Differential diagnosis of keratosis blennorrhagica and psoriasis arthropathica. *Arch. Dermat. & Syph.*, 1939, *40*, 547–559.
7. Hench, P. S. Arthropathia psoriatica. Discussion by O'Leary, P. A. *Proc. Staff Meet., Mayo Clin.*, 1927, *2*, 89–90.
8. Hench, P. S., Bauer, W., Fletcher, A. A., Ghrist, D., Hall, F., and White, T. P. The Problem of rheumatism and arthritis: review of American and English literature for 1935. *Ann. Int. Med.*, 1936, *10*, 754–909.
9. Jeghers, H., and Robinson, L. G. Arthropathia psoriatica. *J.A.M.A.*, 1937, *108*, 949–952.
10. Jungman, H., and Stern, V. S. Unusual case of joint disease (possible example of arthritis psoriatica). *Brit. J. Radiol.*, 1944, *17*, 383–385.
11. Madden, J. F. Psoriasis; clinical and laboratory statistical study. *Minnesota Med.*, 1939, *22*, 381–385.
12. Marie, P., and Léri, A. Une variété rare de rheumatism chronique: la main en lorgnette. *Bull. et mém. Soc. méd. hôp. de Paris*, 1913, *36*, 104–107.
13. Nordin, G. Fatal case of psoriasis arthropathica. *Acta dermat.-venereol.*, 1934, *15*, 221–242.
14. Plenk, H. P. Arthritis: is an x-ray classification justified. To be published.
15. Shlionsky, H., and Blake, F. G. Arthritis psoriatica. *Ann. Int. Med.*, 1936, *10*, 537–546.
16. Tobias, N. Modern management of psoriasis. *Internat. Clin.*, 1939, *3*, 173–182.

CYSTOURETHROGRAPHY IN THE DIAGNOSIS OF DISEASES OF THE PROSTATIC URETHRA*

By ROBERT C. THUMANN, JR., M.D.
From Harper Hospital
and
DAVID RANDALL, M.D.
From Receiving Hospital
DETROIT, MICHIGAN

CYSTOURETHROGRAPHY is an effective procedure for the diagnosis of diseases involving the prostatic urethra. A study of 100 cystourethrograms, along with the cystoscopic, the surgical, and the pathological findings has demonstrated this fact.

Today in prostatic surgery on the hyperplastic prostate the size of the gland and its mode of obstruction becomes a determining factor as to the type of surgical procedure undertaken, whether by transurethral resection or by the suprapubic or perineal route. The cystourethrogram offers a means of showing the prostatic lobes involved in the hyperplasia, and presents an adequate estimation of the size of the gland.

The first *cystogram* was made by Keller in 1904 using air as the contrast medium, while Wulff in 1905 and Voelker and von Lichtenberg in 1906 made the first cystograms using an opaque medium.

The first *urethrogram* to show anterior urethral strictures was made by Cunningham in 1910 using an opaque dye. It was not until 1921, however, that Haudek and Prigle of Vienna, using 10 per cent potassium iodide, first demonstrated adequately the prostatic urethra by retrograde instillation, pointing out the necessity of keeping the dye flowing through the urethra while the film is being taken; otherwise, in a moment of stasis the prostatic portion and membranous portion of the urethra will have emptied itself.

In 1933 Flocks reported the double contrast manner of demonstrating the prostatic urethra and vesical neck using air in the bladder and an opaque dye in the urethra injected retrogradely. It is this principle with modification that we follow.

PROCEDURE

Five films are made. After a preliminary flat plate of the abdomen (1), a soft rubber catheter is inserted and the residual urine measured. Two and one-half per cent sodium iodide is then instilled to the point of bladder discomfort or to no more than 500 cc., and a preliminary anteroposterior cystogram made (2). The dye is allowed to drain off and approximately 300 cc. of air is instilled along the catheter. The catheter is removed and a 30 degree right antero-oblique air cystogram taken (3). Holding the same position, a radiopaque substance is instilled retrogradely, and while it is flowing through the urethra the film is exposed (4). The patient is then turned to an anteroposterior position and another double-contrast cystourethrogram taken as the dye is still being instilled along the urethra (5).

Rayopake which comes ready mixed makes an excellent opaque medium for urethrograms. Skiodan, neo-iopax, and diodrast mixed one part to five with a tragacanth and glycerin base of the proper viscosity also makes an excellent medium. There is a tendency to use a too viscous solution which will give poor filling of the urethra, false filling defects, bubbles, etc.

The procedure is *contraindicated* in the presence of lower urinary tract hemorrhage, acute infection, or active chronic prostatitis. Air is never instilled transurethrally except through an inlying catheter.

* Read before the Detroit Branch of the American Urological Association, May 5, 1948.

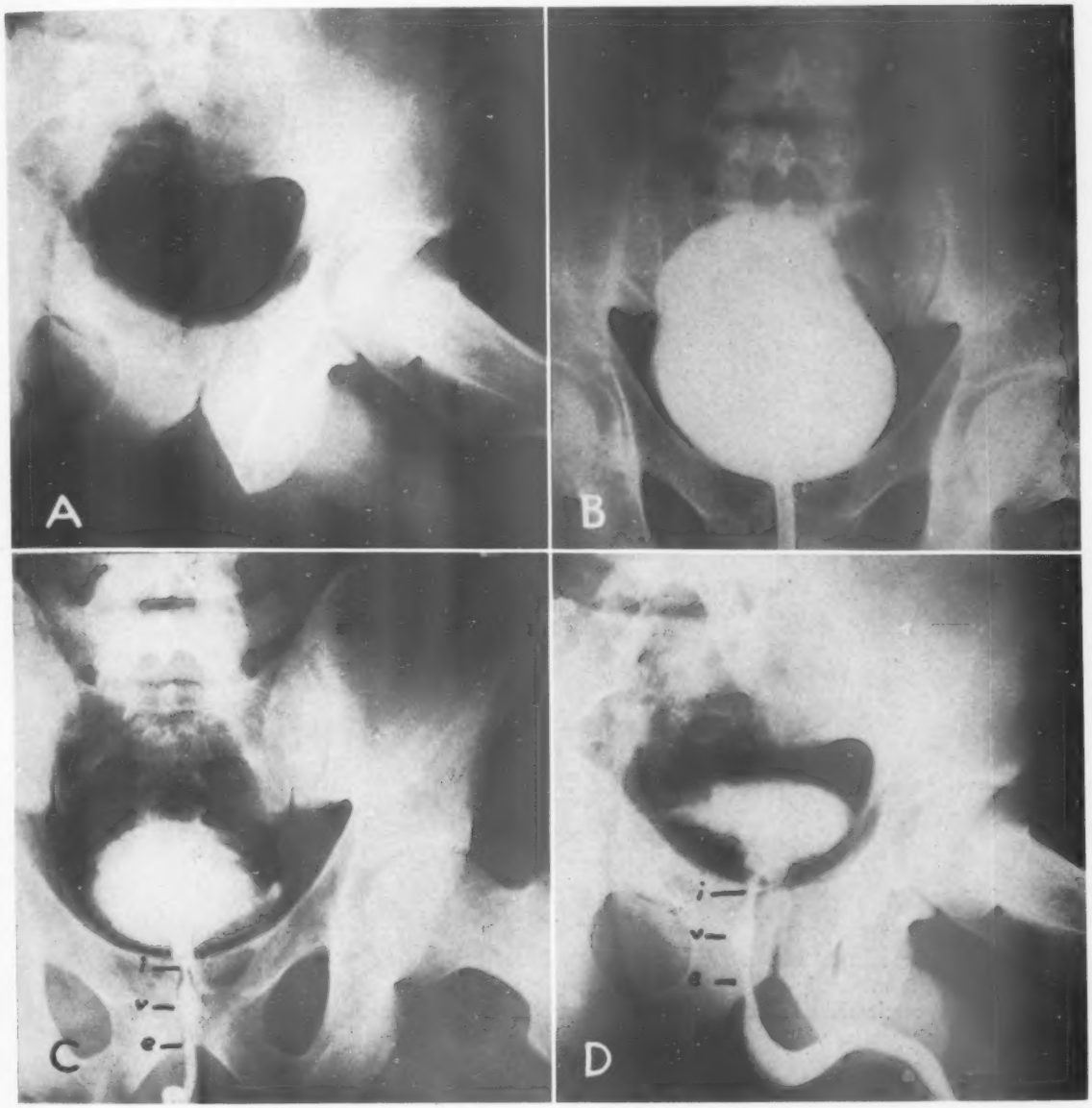

Fig. 1. Normal cystourethrogram. (*A*) Air cystogram. (*B*) Opaque cystogram. (*C*) Anteroposterior cystourethrogram, double contrast. (*D*) Oblique cystourethrogram, double contrast; (*i*) internal spyincter; (*v*) verumontanum; (*e*) external sphincter.

In order to interpret the cystourethrogram, it is necessary to understand and recognize the normal. Figure 1 is representative of the normal appearance of the four films excluding the flat plate of the abdomen usually taken.

No discussion will be made of the opaque cystogram since this paper is primarily concerned with the urethrogram. Note however, should be taken of the relation of the inferior border of the bladder and the superior border of the pubis, the round (or oval) contour of the distended bladder wall, and the smooth outline of its border.

The air cystogram is of value in demonstrating any intravesical protrusion of an enlarged prostate. It will also show to advantage intravesical protruding neoplasms and non-opaque foreign bodies.

The urethrogram presents four points

for consideration when separating the normal from the abnormal in disease involving the prostatic urethra. One must become familiar with (1) the imprint of the external sphincter (membranous urethra), (2) the area and imprint of the verumontanum, (3) the internal sphincter (vesical neck), (4) and the contour and course of the prostatic urethra.

between the external and internal sphincters in the widest portion of the prostatic urethra. This imprint is frequently lost along with that of the external sphincter in urethritis usually associated with enlargement of the prostate due to infection, and in prostatic malignancy involving the urethra. When visualized the imprint of the verumontanum acts as a fixed land-

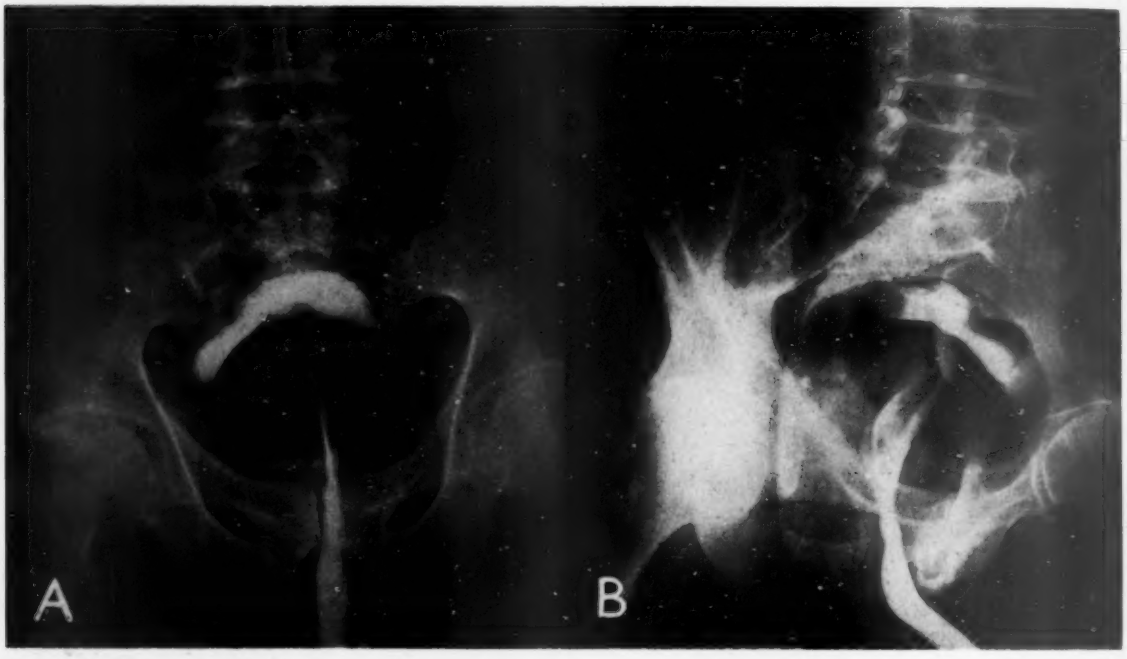

Fig. 2. Oblique spreading. A seventy-six year old man first seen in acute retention with a non-protein nitrogen of 156. Prostate markedly enlarged and smooth per rectum. At suprapubic prostatectomy a 125 gram prostate was enucleated with marked lateral lobe and small median lobe involvement. Pathology: hyperplastic nodular prostate. (*A*) Narrow elongated urethra as shown in anteroposterior view. (*B*) Marked oblique spreading with minimal anterior tilting.

Normally, the *external sphincter* is seen as the narrowest portion of the posterior urethra, 1.5 cm. long, and approximately 3.5 cm. from the vesical neck. It is the least distensible portion of the urethra. It is fixed by the urogenital diaphragm, and it is not involved in prostatic hyperplasia. It thereby acts as an excellent landmark for determining prostatic urethral lengthening by urethrography just as it does on lens inspection.

The *imprint of the verumontanum*, which is a sagittal filling defect or sagittal area of decreased opacity, normally lies midway mark, since prostatic hyperplasia always takes place proximal to it.

The *internal sphincter* lies at the vesical neck as the most proximal portion of the urethra. Normally, it is 1.5 to 2 cm. from the verumontanum, but its position is varied in prostatic enlargement. The internal sphincter is used as one point in the determination of the length of the prostatic urethra. It normally appears about 2 cm. in diameter, but it is narrower than the prostatic urethra, thus giving the prostatic urethra a pyriform configuration.

In the oblique view the *prostatic urethral*

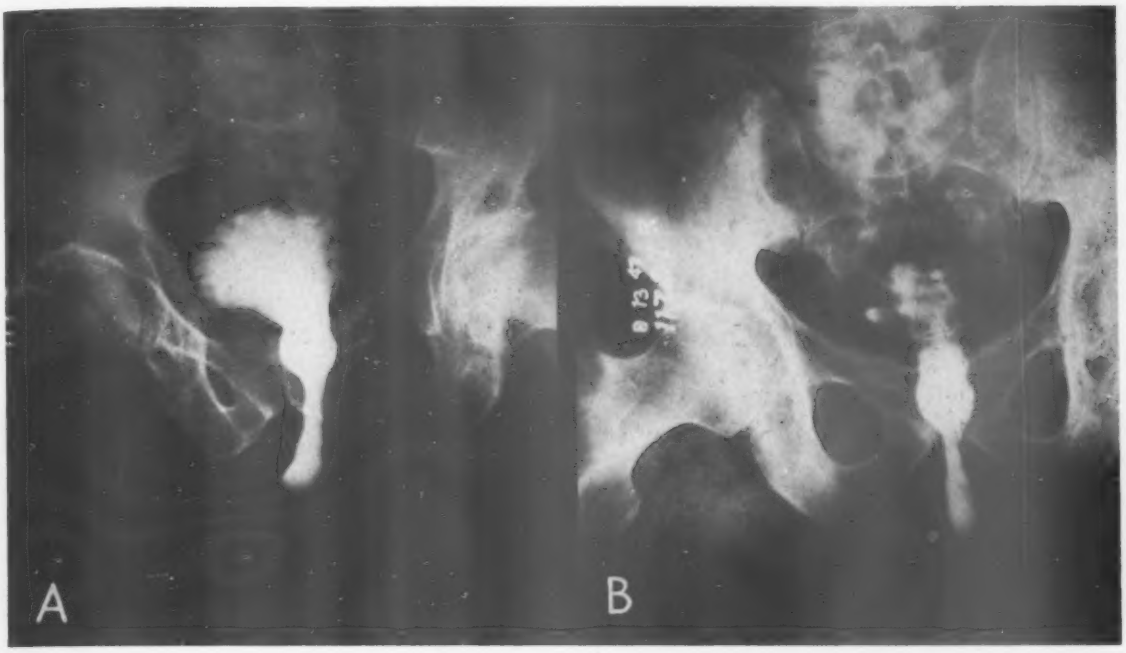

Fig. 3. Funnel spreading from paralysis of the sphincters due to tabes dorsalis. A similar appearance may be seen following prostatectomy. (*A*) Oblique view. (*B*) Anteroposterior view.

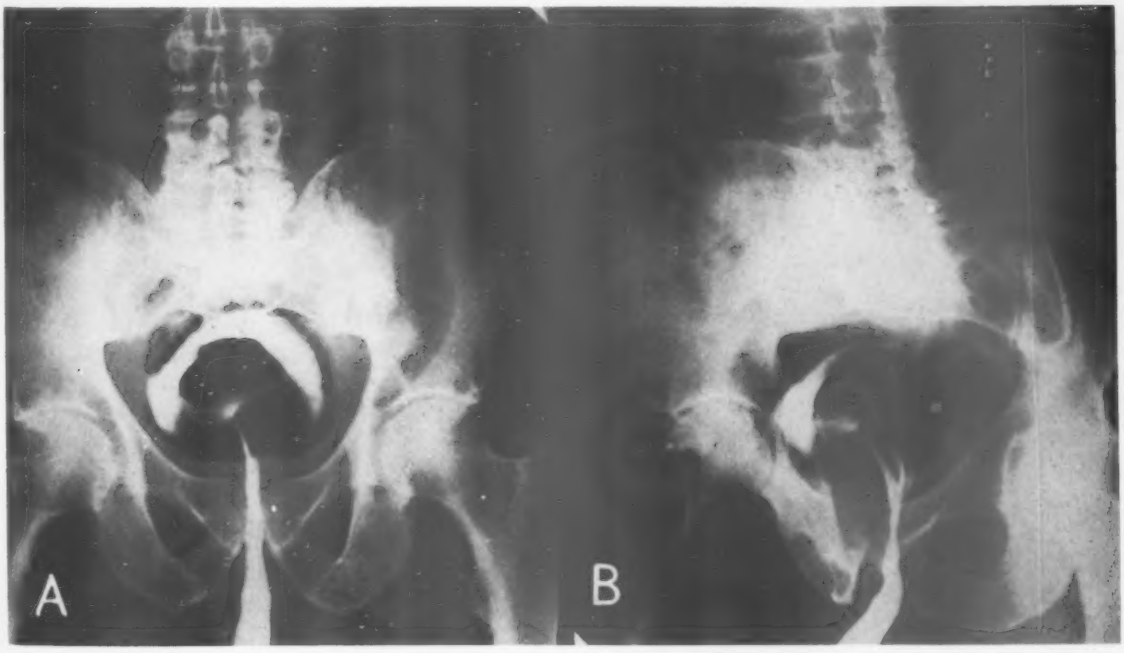

Fig. 4. Anterior tilting and Y-trickling. A seventy-six year old man first seen in acute retention following a long automobile trip who had had prostatism symptoms for five years. A large smooth prostate was palpated per rectum. Cystoscopy revealed enlargement of both lateral lobes and median lobe. Removed by the perineal route; weighed 95 grams. Pathology: hyperplastic nodular prostate. (*A*) Anteroposterior double contrast urethrogram showing a large intravesical prostate, Y-trickling (dye in the sulci between median and lateral lobes), and a narrow elongated urethra. (*B*) Oblique film showing marked anterior tilting (median lobe) and spreading (lateral lobes).

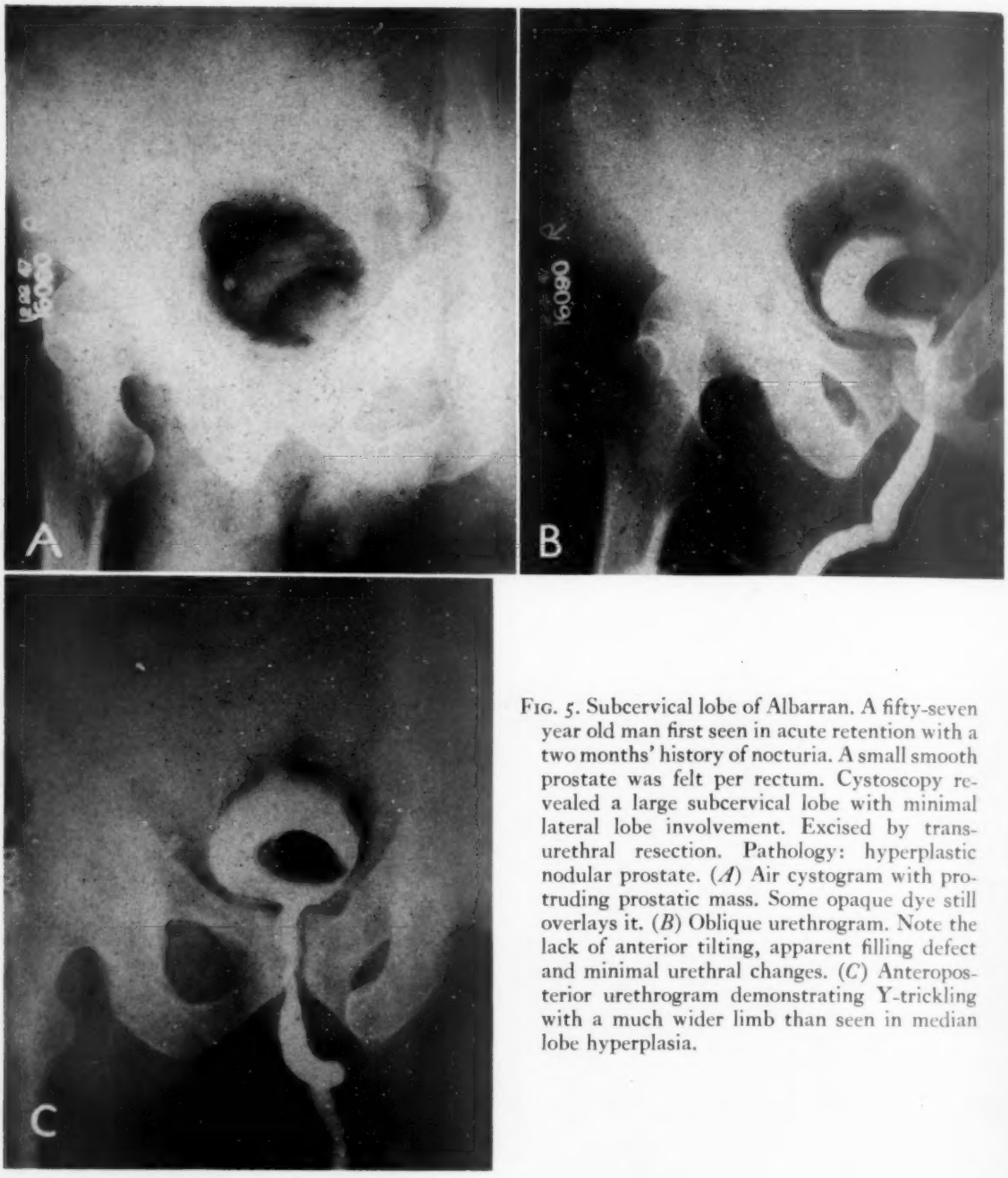

FIG. 5. Subcervical lobe of Albarran. A fifty-seven year old man first seen in acute retention with a two months' history of nocturia. A small smooth prostate was felt per rectum. Cystoscopy revealed a large subcervical lobe with minimal lateral lobe involvement. Excised by transurethral resection. Pathology: hyperplastic nodular prostate. (*A*) Air cystogram with protruding prostatic mass. Some opaque dye still overlays it. (*B*) Oblique urethrogram. Note the lack of anterior tilting, apparent filling defect and minimal urethral changes. (*C*) Anteroposterior urethrogram demonstrating Y-trickling with a much wider limb than seen in median lobe hyperplasia.

contour is gently curved along the anterior border with its convexity posteriad while the posterior border is more greatly curved. This urethral contour is altered in prostatic enlargement.

In pathological lesions of the vesical neck certain changes are noted to which terms have been applied.

The term *spreading* is used to mean any abnormal widening of the prostatic urethra. Several types may occur. Oblique spreading (Fig. 2) begins just proximal to the verumontanum and may or may not extend to the internal sphincter. It is due to the intraurethral protrusion of enlarged lateral lobes. Narrowing of the prostatic urethra in the anteroposterior view is usually an associated finding. The urethra may be

FIG. 6. Tubular urethra in carcinoma of the prostate. Note straightening of the urethra with loss of its normal curves, absence of the verumontanum and external sphincter imprints, and abnormal irregularities of the urethra in the oblique view near the internal sphincter. Fibrosis of the posterior urethra may give this same picture. The associated osteoblastic bone lesions are also well shown in the study.

FIG. 7. Contracture of the vesical neck due to long-standing infection. A twenty-nine year old male first seen with an extensive granulomatous lesion of the right inguinal area, penis, and scrotum, and a permanent perineal urethrotomy with a marked stricture of the meatus, remaining bulb, and membranous urethra. A diagnosis of granuloma inguinale (confirmed by our biopsy) had been made two years previously and the perineal urethrotomy performed one year later because of extensive destruction of the penis and anterior urethra. Note the narrowing at the vesical neck and extensive stricture of the membranous and bulbous urethra. The granuloma healed rapidly with streptomycin and a retransplant and reconstruction of the perineal urethrotomy was performed. The contracture responded well to dilatation.

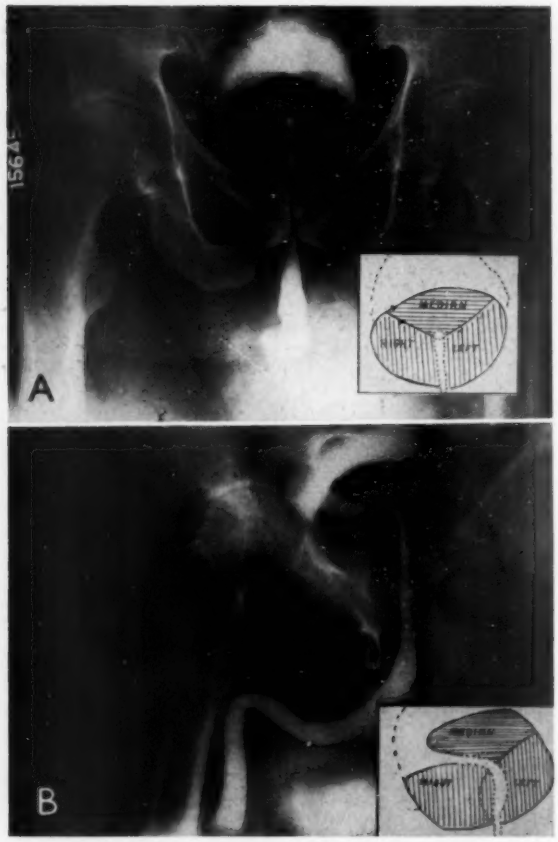

Fig. 8. Trilobar prostatic hyperplasia with lateral lobe and median lobe involvement. Insets demonstrate the position of the prostatic lobes. (*A*) Anteroposterior double contrast urethrogram showing an intravesical protruding prostate and an elongated narrow urethra. Note the apparent blockage of the dye in the urethra as it is bent at right angles by the median lobe, best demonstrated in the oblique view. (*B*) Oblique view showing spreading and anterior tilting.

visualized as a slit which produces widening in the oblique, narrowing in the anteroposterior view. Spreading in the anteroposterior view may occasionally be seen from interdigitation of the lateral lobes across the midline. Funnel spreading (Fig. 3) is a V-shaped widening at the vesical neck, extending to or beyond the external sphincter as seen in both the anteroposterior and oblique views. Funnel spreading occurs in paralysis of the vesical neck and excision or destruction of the internal sphincter following prostatectomy.

The *anterior tilting* (Fig. 4) of the prostatic urethra is a characteristic finding of enlargement of the median lobe. It is seen in the oblique views. This deviation of the urethra is frequently poorly determined or missed in cystoscopic examinations because the rigid sheath of the instrument depresses any mid-lobe posteriorly.

The term *Y-trickling* (Fig. 4, 5) has been applied to the appearance presented as the dye flows through the slits formed by a midlobe and lateral lobes. Sometimes an apparent round or oval intravesical filling defect in the midline is seen, significant of the presence of the subcervical lobe of Albarran (Fig. 5) The short-based subcervical lobe inside the internal sphincter produces this apparent phenomenon.

Tubular urethra (Fig. 6) is the straight tube-like prostatic urethra seen in all views, which occurs in the periurethral induration associated with prostatitis, the fibrosis from long standing infection of the urethra or prostate, and the encroachment and invasion of the periurethral tissue from prostatic malignancy. Loss of the external sphincter and verumontanum imprints frequently accompanies this type of picture.

Narrowing (Fig. 7) of the normal urethral diameter occurs from any lesion encroaching on the lumen. It may be localized as in vesical neck contractures, median bars, congenital strictures or valves; or diffuse as seen in prostatic enlargement or certain contractures of the urethra.

Lengthening refers to the increase in length of the prostatic urethra from the normal such as occurs in prostatic enlargement. Since the external sphincter and verumontanum are fixed points, the length of the urethra may be measured from either of these two points.

Elevation of the bladder superiorly occurs in intraurethral prostatic encroachment, and is usually due to the lateral lobes.

Certain of the above listed features of a cystourethrogram aid in the diagnosis of pathological lesions involving the vesical neck.

In order to correlate the findings of the cystourethrogram in prostatic hyperplasia, one must first recognize the prostatic lobes

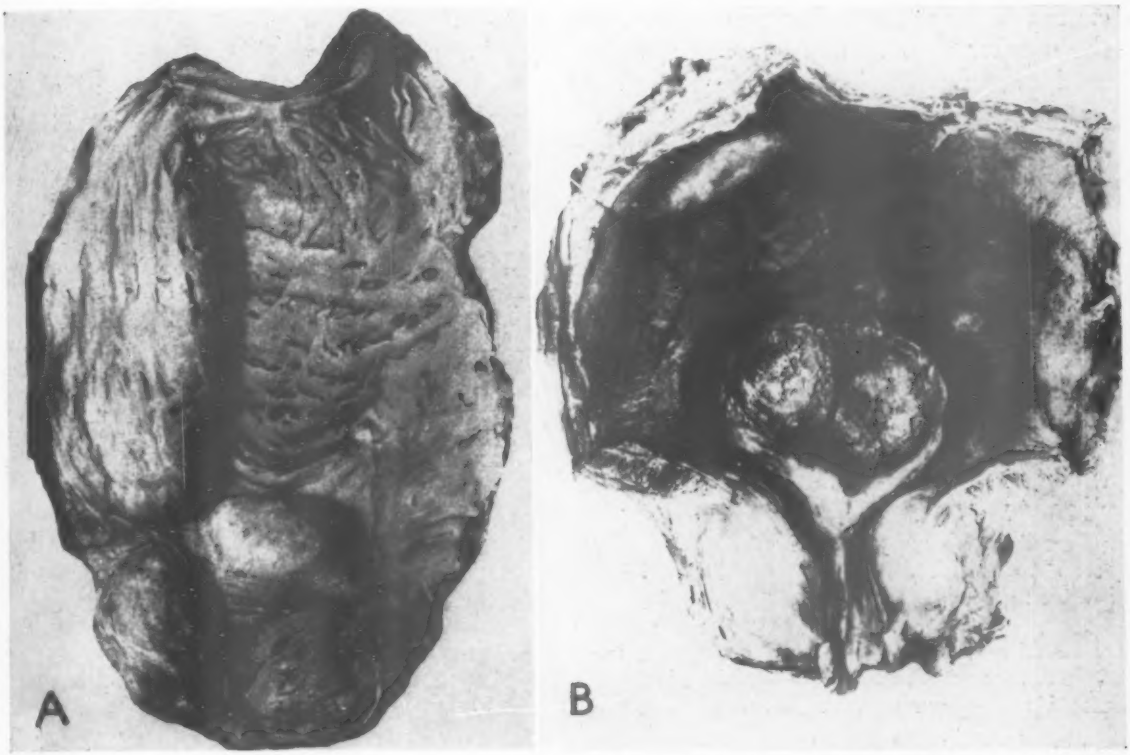

Fig. 9. Pathological specimens of trilobar prostatic hyperplasia with the median lobe (*A*) and subcervical lobe of Albarran (*B*) from Randall's "Surgical Pathology of Prostatic Obstructions," Williams and Wilkins Company, Baltimore, 1931, to demonstrate better the cause of Y-trickling and anterior tilting in cystourethrography. (Plates 3 and 5, pp. 30 and 34; reproduced by permission.)

involved in the process. It is generally thought today that the hyperplasia occurs in the periurethral glands and accessory ducts of the prostate, and not in the true prostatic glandular tissue. It can thus be seen why hyperplasia of the posterior lobe rarely, if ever, occurs, since these structures are not contained in this lobe.

For practical purposes four lobes are considered, realizing that hyperplasia may rarely be present in the anterior lobe and in the subtrigonal lobe of Home. By cystourethrography the lateral lobes, the median lobe, and the subcervical lobe of Albarran in hyperplasia present distinctive appearances (Fig. 8).

There is nothing which will specifically make the diagnosis of prostatic cancer. However, when the urethra becomes involved in the process, many times an appearance suggesting cancer of the prostate is presented. A straight tubular urethra with loss of the verumontanum and external sphincter imprints may suggest a cancerous prostate, but long standing chronic prostatic urethritis may also present the same cystourethrographic picture. Deformities, irregularities, and deviations of the urethra are highly suggestive of prostatic neoplasm; however, tuberculosis of the prostate and some contractures of the urethra may present similar findings.

CONCLUSIONS

The value of visualizing directly the urethra and bladder with the cystoscope cannot be denied nor replaced; however, many factors are encountered which may be misinterpreted, and frequently there are undesirable complications after observation cystoscopy.

In extensive prostatic enlargement, all portions of the bladder cannot be seen with the cystoscope; the urethra and bladder

cannot be seen as one, but only in sections; the urethra is artificially converted into a straight tube by the rigid sheath of the instrument, theregy obliterating any abnormal contour (Stegeman[15,16]); competent urologists at times misinterpret the size and type of the prostate gland in a given patient (Crabtree and Brodny[5]); and cystoscopy is a more traumatic procedure, more painful, and often carries an unpleasant mental impression. In addition, the cystourethrogram gives a permanent graphic record with which to trace the operative results after prostatic surgery. It is an excellent means of demonstrating prostatic disease.

Robert C. Thumann, Jr., M.D.
19106 Moross Rd.
Detroit 24, Mich.

REFERENCES

1. Beer, E. Visualization of amount of residual urine. *J.A.M.A.*, 1936, *107*, 1886; correction, 1936, *107*, 2060.
2. Brodny, M. L., and Robins, S. A. Enuresis; use of cystourethrography in diagnosis. *J.A.M.A.*, 1944, *126*, 1000–1006.
3. Brodny, M. L., and Robins, S. A. Use of new viscous water-miscible contrast medium rayopake for cystourethrography. *J. Urol.*, 1947, *58*, 182–184.
4. Colby, F. H., and Suby, H. I. Cystourethrograms; roentgen visualization of urethra, bladder and prostate. *New England J. Med.*, 1940, *223*, 85–92.
5. Crabtree, E. G., and Brodny, M. L. Estimate of value of urethrogram and cystogram in diagnosis of prostatic obstruction. *J. Urol.*, 1933, *29*, 235–276.
6. Flocks, R. H. Roentgen visualization of posterior urethra. *J. Urol.*, 1933, *30*, 711–736.
7. Hager, B. H., and Braasch, W. F. In: Lewis' Practice of Surgery. W. F. Prior Company, Inc., Hagerstown, 1947, VIII, 1, 67–79.
8. Hyams, J. A., Kenyon, H. R., and Kramer, S. E. Urethrocystography in male. *J.A.M.A.*, 1933, *101*, 2030–2035.
9. Keller, O. Value of urethrographs from practical and clinical viewpoint. *Hospitalstid.*, 1930 *73*, 583–596.
10. Kerr, H. D., and Gillies, C. L. The Urinary Tract: A Handbook of Roentgen Diagnosis. The Year Book Publishers, Inc., Chicago, 1944, pp. 229–311.
11. Knutsson, F. Technique of urethrography. *Acta radiol.*, 1929, *10*, 437–441.
12. Macnish, J. M. Cysto-urethrography in male. *Urol. & Cutan. Rev.*, 1936, *40*, 77–81.
13. Migliardi, L. La cysto-uréthrographie descendante; sa technique et ses indications. *J. d'urol.*, 1935, *40*, 499–511.
14. Pfahler, G. E. Injection of air for roentgen diagnosis of tumors of bladder. Am. J. Roentgenol., 1919, *6*, 371–375.
15. Stegeman, W. Cystourethrograms; use, technique, and advantages, especially before prostatectomy. *J. Urol.*, 1941, *46*, 549–554.
16. Stegeman, W. Misinterpretations of enlarged prostates gained through cystoscopy. *J. Urol.*, 1947, *57*, 479–483.
17. Sweetser, T. H. Cystography, especially pneumocystography as guide in treatment of vesical neck lesions. *J. Urol.*, 1938, *40*, 285–293.

Vol. 64, No. 4

MULTIPLE DESTRUCTIVE PROCESSES OF THE PHALANGES OF THE HAND WITH SIMULTANEOUS CALCIFICATIONS OF THE SOFT TISSUES OF INDEFINITE ETIOLOGY*

By F. BOHATIRCHUK†

From the Department of Roentgenology, IRO Hospital

BAYREUTH, GERMANY

THERE are several cases in the routine practice of every roentgenologist which cannot be given an exact diagnosis. One of these cases is presented below.

Patient L.S., Esthonian, female, aged fifty-three, wife of a physician (roentgenologist), mother of two children, came to our hospital with the following complaints: pains of uncertain localization in different extremities; shortening of the fingers; extreme sensitivity to changes of temperature, especially to cold, and a weak heart. The patient dates her illness from 1935 when she felt very severe pains in the upper part of the right arm. Soon after that the pain appeared also in the same part of the left arm. Without any special treatment the pains disappeared within two months. Her climacteric occurred in 1937. In 1938–1939 the patient began to observe that the fingers on both hands were becoming thicker and shorter and she was obliged to remove her rings. At the same time she noticed that the fingers became numb. A roentgenogram did not reveal any pathological condition of the bone. In 1940–1941 the disease progressed slowly. In 1941 the diagnosis was "a rare form of rheumatism." This time the roentgenogram showed some bone changes (patient did not know their nature). After 1941 she was not treated further. During the course of the condition there was never any elevation of temperature. The fingers were always cold. Superficial excoriations or deeper lesions were often present on the thickened fingers. In the secretions she has never seen any bone sequestra.

FIG. 1

* Read at a joint conference of 120 American Hospital and Society of DP Doctors in Bayreuth, Germany, July, 15, 1947.

† Now at the University of Ottawa, Ottawa, Canada.

FIG. 2

Physical Examination. The patient is a rather thin female; skin is pale. Height, 162 cm., weight, 56 kg. The fingers on both hands are short and thick (Fig. 1); on palpation the plump parts of the fingers are tight but not painful. One can palpate on the proximal ends of both humeri medially bone-like immovable structures. Considerable kyphosis is present.

The heart is slightly enlarged, tones of the heart harsh, aortic tone accentuated. At the time of admission blood pressure was 190/85; once during the examination the blood pressure was 200/80. Lungs and abdomen were negative. The patient refused to undergo gynecological examination.

Blood: calcium, 18 mg.; sugar, 88 mg.; hemoglobin, 71 per cent; color index, 0.82; erythrocyte count, 4,300,000; leukocyte count, 10,400; Schilling test, normal; Wassermann reaction, negative.

Urinalysis showed a pH of 6.0, specific gravity of 1.012; albumin and sugar negative.

Roentgen Findings. Hands (Fig. 2): The proximal two-thirds of the distal phalanges,

FIG. 3 (*A*) and (*B*)

together with the distal third of the middle phalanges of the index, middle, ring and small fingers of both hands and the proximal half of the distal phalanx of the thumb and the distal half, including the articular surface of the proximal phalanx of the left thumb, showed marked destructive changes similar to those observed in the fingers of both hands. These destructive changes exhibited themselves as fragmentations of the phalanges with marked increase in the bone density in the areas of destruction.

The right humerus (Fig. 3*A*) shows normal bone structure. Several formations of bone density are seen lying close to the humeral shaft. The formations are not uniform; they are

Fig. 4

closely connected with the bone. In the shoulder joint capsule several calcifications are seen, manifestations of bursitis calcarea.

In the left humerus (Fig. 3*B*) two large calcified formations are seen in the same area as those on the right side. Bursitis calcarea is also present.

In the spine extensive calcifications are shown in the paravertebral ligaments; in some places they show considerable density (Fig. 4, 5 and 6). On the right side of the fifth, sixth and seventh cervical vertebrae a massive calcification is seen of uniform structure. There is no destructive

Fig. 5

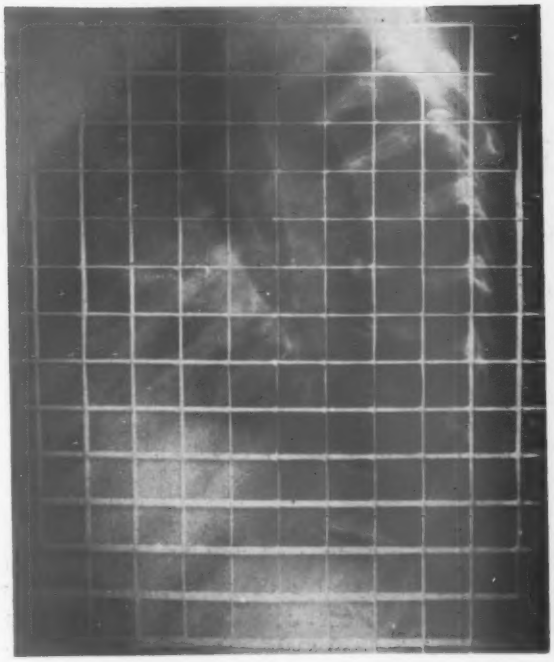

Fig. 6

process seen in the vertebrae. The calcification lies close to the vertebral bodies.

In the right foot the soft tissues of the fifth toe contain several calcifications; all bones of the foot are normal.

No pathological changes are seen in other portions of the skeleton. In other soft tissues small calcifications are occasionally seen.

The heart is moderately enlarged due to a myocarditis. Calcifications were observed in the wall of the aorta and on the mitral valves.

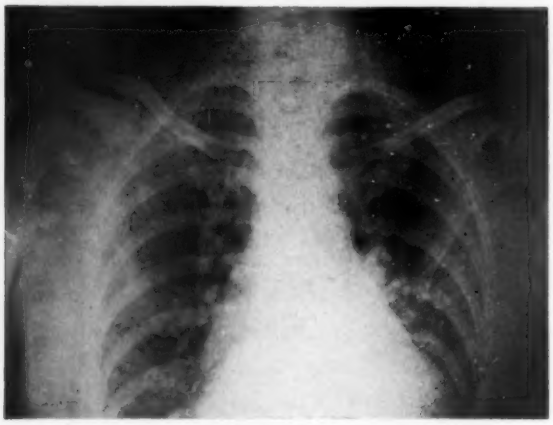

FIG. 7

The lung tissue is normal. Calcification was observed in the hilar lymph nodes. The nervous system was essentially negative, except for the above mentioned extreme sensitivity to temperature changes.

DISCUSSION

The multiplicity of the bone changes and apparent symmetry of the localization of the destructive process speak against the possibility of a local infectious origin of the disease. The destructive process is apparently due to some general central cause. The irregularity in the distribution of the calcium is manifested by numerous calcifications in the soft tissues. The destructive process of the phalanges simulates closely that of aseptic necrosis. The disturbances in the local blood circulation or the neurotrophic disturbances, or both, could be the cause of this necrosis. We consider the presence of arthrotic changes (right fifth finger) to be of great importance in the diagnosis.

Diagnosis. The disease began during the preclimacteric when hormonal disturbances occur most frequently. The patient asserts that the pains in the arms were the first symptom of the disease. Most likely these pains were in connection with the formation of the above mentioned large calcium deposits. It is not easy to understand why, after twelve years, the disturbances of calcium metabolism occurred and why the glandular deficiency provoked this disturbance. The slight increase in blood calcium can now be taken into consideration only with reservations. Probably hyperparathyroidism was the primary cause of the disease. We presume that the calcium formations were the cause for the development of irregularities in blood circulation in both hands. At this stage of the disease the patient felt the above mentioned numbness and the decrease of sensitivity in the fingers. It is probable also that at this stage of her illness the patient suffered from some form of polyarthritis which, in the presence of the deficient blood circulation, produced aseptic necrosis of the phalanges. We must recall the famous experiment of Samuel: If we provoke anemia of the ear of a rabbit and afterwards grease this ear with croton oil a sudden necrosis will develop; while the greasing of the ear of a normal rabbit will produce only inflammation.

Though in the literature accessible to us we could not find a similar case, theoretically we can admit the possibility of a neurotrophic disturbance as a consequence of some pathologic process in the cervical portion of the spinal cord in our patient, since calcium deposits were observed in the region of the lower cervical vertebrae. It is necessary to differentiate the condition also from syringomyelia and from neoplasm. It would seem that the presence of kyphosis, of the large area of calcification in the cervical part of the vertebrae and of the extreme sensitivity to changes of temperature are in favor of syringomyelia. But against this are the symmetry of localization, the absence of paralysis and typical anesthesia. Syringomyelia usually begins

at a younger age. Against neoplasm are also the symmetry of the bone changes, the absence of typical disorders of sensitivity and the chronic course of the disease. We have observed the patient over a period of five months and during this time we have not noted any progression of the disease. Lues as the primary cause of the disease is yet less probable, since repeated Wassermann tests were negative.

Treatment. In the absence of a definite diagnosis, the treatment has of course been only symptomatic. Hormonal treatment produced very little effect. We have recently sent the patient for roentgen therapy of the cervical portion of the spinal cord but we do not expect any considerable effect.

X-Ray Laboratory
Department of Anatomy
University of Ottawa
Ottawa, Canada

THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

Editor: Lawrence Reynolds, M.D. *Assistant Editor:* Ruth Bigelow, B.S.

Associate Editors: Traian Leucutia, M.D., Edward B. D. Neuhauser, M.D., Wendell G. Scott, M.D.
Consulting Editorial Board: See front cover.
Published by: Charles C Thomas, Publisher, 301–327 East Lawrence Avenue, Springfield, Illinois.

Issued monthly. Annual subscription: United States, Mexico, Cuba, Central and South America, $10.00; Canada, $11.00; other countries, $12.00. Advertising rates submitted on application. Editorial office, 110 Professional Building, Detroit 1, Michigan. Office of publication, 301–327 East Lawrence Avenue, Springfield, Illinois. Information of interest to authors and readers will be found on page iv.

Officers and Standing Committees

AMERICAN ROENTGEN RAY SOCIETY

President: U. V. Portmann, Cleveland, Ohio; *President-Elect:* B. P. Widmann, Philadelphia, Pa.; *1st Vice-President:* Arthur E. Childe, Winnipeg, Man.; *2nd Vice-President:* Robert C. Pendergrass, Americus, Ga.; *Secretary:* Barton R. Young, Philadelphia, Pa.; *Treasurer:* Wendell G. Scott, 510 South Kingshighway Blvd., St. Louis 10, Mo.

Executive Council: U. V. Portmann, B. P. Widmann, A. E. Childe, R. C. Pendergrass, B. R. Young, W. G. Scott, Lawrence Reynolds, J. T. Case, H. G. Reineke, R. A. Arens, R. C. Beeler, J. B. Edwards, E. E. Barth, P. A. Bishop, M. J. Geyman, Chairman, Cottage Hospital, Santa Barbara, Calif.

Program Committee: B. R. Young, Philadelphia, Pa., J. T. Case, Chicago, Ill., Lawrence Reynolds, Detroit, Mich., R. A. Arens, Chicago, Ill., M. J. Geyman, Santa Barbara, Calif., B. P. Widmann, Chairman, 250 South Eighteenth St., Philadelphia, Pa.

Publication Committee: R. J. Reeves, Durham, N. C., P. C. Swenson, Philadelphia, Pa., J. T. Case, Chairman, Chicago, Ill

Finance Committee: E. L. Jenkinson, Chicago, Ill., S. A. Wilson, Salem, Mass., H. G. Reineke, Chairman, Cincinnati, Ohio.

Committee on Scientific Exhibits: E. B. D. Neuhauser, Boston, Mass., C. A. Good, Rochester, Minn., R. A. Arens, Chairman, Michael Reese Hospital, Chicago. Ill.

Representative on National Research Council: Robert P. Bull, New York, N. Y.

Editor: Lawrence Reynolds, 110 Professional Building, Detroit 1, Mich.

Assistant Editor: Ruth Bigelow, 110 Professional Building, Detroit 1, Mich.

Fifty-first Annual Meeting: Jefferson Hotel, St. Louis, Mo., September 26–29, 1950.

AMERICAN RADIUM SOCIETY

President: Leland R. Cowan, Salt Lake City, Utah; *President-Elect,* Hugh F. Hare, Boston, Mass., *1st Vice-President:* Howard B. Hunt, Omaha; Nebr.; *2nd Vice-President:* Franz J. Buschke, Seattle, Wash.; *Secretary:* John E. Wirth, U. S. Marine Hospital, Baltimore, Md.; *Treasurer:* Grant H. Beckstrand, 110 Pine Ave., Long Beach 2, Calif.

Executive Committee: Charles L. Martin, Chairman, Dallas, Texas, A. N. Arneson, St. Louis, Mo., Maurice Lenz, New York, N. Y.

Program Committee: Leland R. Cowan, Chairman, Salt Lake City, Utah, Joseph Farrow, New York, N. Y., John L. Pool, New York, N. Y.

Publication Committee: Edward H. Skinner, Chairman, Kansas City, Mo., Simeon T. Cantril, Seattle, Wash., Harry Hauser, Cleveland, Ohio.

Education and Publicity Committee: James A. Corscaden, Chairman, New York, N. Y., John F. Hynes, Wilmington, Del., Grant H. Beckstrand, Los Angeles, Calif.

Janeway Lecture Committee: Douglas Quick, Chairman, New York, N. Y., G. Failla, New York, N. Y., F. W. O'Brien, Boston, Mass.

Representatives on American Board of Radiology: Douglas Quick, Chairman, New York, N. Y., B. P. Widmann, Philadelphia, Pa., F. W. O'Brien, Boston, Mass.

Committee on Arrangements: Gordon P. McNeer, Chairman, New York, N. Y., Gray H. Twombly, New York, N. Y., Theodore R. Miller, New York, N. Y.

Advisory Committee on X-ray and Radium Protection of the National Committee on Radiation Protection: Edith H. Quimby, New York, N. Y., John E. Wirth, Baltimore, Md.

Exhibit Committee: Robert E. Fricke, Chairman, Rochester, Minn., William Harris, New York, N. Y., Milton Friedman, New York, N. Y.

Thirty-Third Annual Meeting: Atlantic City, N. J., 1951.

EDITORIAL

SIXTH INTERNATIONAL CONGRESS OF RADIOLOGY

THE Sixth International Congress of Radiology occurred in London, England, from July 23 to 29, 1950. Under the patronage of His Majesty King George the Sixth, the Congress was officially opened by the Rt. Hon. the Earl of Athlone, K.G., who was accompanied by Her Royal Highness Princess Alice, Countess of Athlone. The installation of the President, Dr. Ralston Paterson, was scheduled to be made by Dr. Arthur C. Christie, President of the Fifth Congress. Inasmuch as Dr. Christie was unable to be present, the installation ceremony was carried out by Dr. Benjamin H. Orndoff, Secretary of the Fifth International Congress of Radiology.

During the week of the Congress the scientific work was organized under four divisions: (1) Radiodiagnosis, (2) Radiotherapy, (3) Radiobiology, and (4) Radiophysics. Each morning a "symposium" was held in the "Great Hall," at which achievements in radiology which have occurred since 1937 were presented by invited speakers from various countries, in addition to papers on various topics of interest to the majority of members of the Congress. In the afternoon, sessions were held in eight different rooms, dealing with topics under the four main divisions mentioned above. Particular attention was paid to the diagnostic problems connected with the study of the small intestine, to arthrography, to angiocardiography, to disease of the osseous system associated with blood dyscrasias, to mass surveys of the chest, to radiotherapy of carcinoma of the breast, to the problem of radiological units and radiation genetics. Because of the large number of papers, it was impossible to allot any time for general discussion. The number of papers included, (1) Symposia (papers given by invitation): Diagnosis 30, Therapy 29, Biology 24, Physics 25, and (2) Proffered papers: Diagnosis 112, Therapy 103, Biology 30, Physics 49, Electrology 9; a grand total of 410, of which 71 came from the United States. Excellent abstracts of most of the papers were printed in book form and were given to members at the time of registration.

In Central Hall eighty-five scientific exhibits were set up by radiologists from all over the world. The technical exhibit was large and well attended, eighty manufacturers being represented. The material on display varied from small packages of x-ray opaques up to the 24 million volt betatron. On Friday afternoon Her Majesty Queen Mary spent two hours visiting the technical exhibit under the guidance of President Paterson.

The social side of the Congress was very interesting.

On Monday evening, July 24, at the historic Guildhall, a dinner was given by the British Radiologists, which was attended by 644 people. Here a cordial welcoming speech was made by Lord Louis Mountbatten, Vice-Admiral of the Fleet. At this dinner the visitors had the opportunity to see some of the ancient pageantry connected with formal dinners in England. The program was run by an official "toastmaster" whose voice was powerful beyond description. This dinner will never be forgotten by any of the visitors who had the good fortune to be present.

On Tuesday evening the Faculty of Radiologists, under the presidency of Prof. Brian Windeyer, held a reception at the Royal College of Surgeons, at which Honorary Fellowships were conferred upon five radiologists, including Dr. Arthur C. Chris-

tie and Dr. George E. Pfahler. Following this, a reception by H. M. Government was held at the Tate Gallery. The visitors were received by the Rt. Hon. Aneurin Bevan, P.C., M.P., Minister of Health. Following this reception the members of the Congress were invited to a special motion picture show of "Trio" at the Odeon.

On Wednesday evening the Congress took over Covent Garden for a performance of the New York Ballet Company under the direction of the famous New York choreographer George Balanchine. This performance was described by those fortunate enough to be present as well worthy of the best traditions of the choreographer's art. Preceding the Ballet performance receptions were held by various medical and allied organizations. A dinner party was given to the Delegates by the Royal College of Surgeons.

On Thursday evening the entire membership of the Congress was invited to a Garden Fete at the Hurlingham Club, a large Country Club in the suburbs of London. Here were given exhibitions of folk dancing by groups in appropriate costumes from various parts of Great Britain, songs by a Welsh Men's chorus, as well as exhibitions of diving and other sporting displays. A Buffet Supper was served and the entertainment was concluded with a beautiful display of fireworks.

On Friday evening the Congress Ball occurred at the Savoy Hotel. Entertainment was given by excellent professionals, which included a magician who amused the audience by pretending to saw President Paterson in two.

The business of the International Congress is handled by: (1) The International Executive Committee which is composed of the President of the Congress as Chairman, the three immediate past presidents of the Congresses, and the Chairman of the delegation of seven countries selected by ballot by all of the National Delegations, and (2) the International Committee composed of all of the National Delegations attending the Congress. According to the Constitution, each delegation has one vote which is expressed by its Chairman. Certain actions of the International Committee are of general interest.

It was reported that all of the records of the previous International Congresses of Radiology were lost due to the bombing of Hamburg during World War II. The International Committee voted to join the Council for the Co-ordination of International Congresses of Medical Sciences (CCICMS). This was organized under the auspices of the World Health Organization (WHO) and the United Nations Educational, Scientific and Cultural Organization (UNESCO). After preliminary conferences in 1947 and in 1948, CCICMS was organized in Brussels in April, 1949, by representatives of forty-two international medical societies of one sort or another. The Council is publishing a Quarterly Bulletin, the first number of which was put out in January, 1950, from Unesco House, 19 Avenue Kléber, Paris (16e). Information about any international medical meeting can be obtained from the Council at the above address.

The Delegation from the United States introduced a resolution to eliminate "Phototherapy" and "Medical Electrology" from the programs of the International Congress of Radiology. After considerable discussion, the committee voted to eliminate "Medical Electrology" but to retain "Phototherapy."

The Delegation from Mexico introduced a resolution to change the intervals between International Congresses of Radiology from three to four years. This resolution was strongly supported by the Delegation from the United States, but was defeated by two votes out of the thrity delegations voting.

The delegates from the United States to the Sixth International Congress of Radiology recommended that a committee be appointed to consider stage grouping of cases of cancer of the breast for uniformity in reporting results of treatment. The

International Executive Committee of the Congress recommended the appointment of an international committee not only to consider cancer of the breast but also cancer in other anatomic locations. The recommendation was approved by the Official Delegates to the Congress. The committee was named the "International Provisional Committee for the Staging of Cancer and the Presentation of the Results of the Treatment of Cancer." It was abbreviated to "I.C.R.C." Dr. J. Heyman, Stockholm, Sweden was named chairman.

The I.C.R.C. met on July 29, 1950, at the Royal Academy of Surgeons, London, and decided to limit its activities for the present to cancer in only three locations. The following were appointed to study and report on these sites:

(1) Cancer of the uterus
Dr. J. Heyman, Stockholm, Sweden
(2) Cancer of the larynx and pharynx
Dr. F. E. Leborgne, Montevideo, Uruguay
(3) Cancer of the breast
Dr. U. V. Portmann, Cleveland, Ohio

The activities of the I.C.R.C. will be conducted by correspondence and it is planned to make reports at the next International Congress to be held in Copenhagen, Denmark, in 1953. Suggestions will be acceptable from those interested in these problems.

The following are members of the I.C.R.C.

Asia	Dr. K. P. Mody, F.C.P.S. Tata Memorial Hospital, Bombay, India
Belgium	Professeur J. H. F. Maisin Institut du Cancer de l'Universite de Louvain, 61 Voer des Capucin, Louvain
Canada	A. Hardesty Sellers Medical Statistician Department of Health for Ontario East Block, Parliament Buildings Toronto, Canada
Denmark	Dr. J. Clemmesen Cancerregistret Strandboulevarden 49, Kopenhamn
France	M. le Docteur P. F. Denoix Institut National d'Hygiene 45, Rue Cardinet, Paris
Germany	Professor Dr. Med. H. Holthusen Krankenhaus St. Georg, Hamburg Goernestrasse 29
Great Britain	Dr. J. G. McWhirter, D.M.R. Thorndene, 32, Lockerbie Road, Dumfries
Italy	Professor F. Perussia Instituto del Cancero, Milano
South America (Uruguay)	Dr. F. E. Leborgne Instituto de Radiologia, Montevideo
Sweden	Professor J. Heyman (Chairman) Radiumhemmet, Stockholm 60
Switzerland	Professor H. R. Schinz Röntgeninstitut, Kantonspital, Zurich
United States of America	Dr. U. V. Portmann, M.D. Cleveland Clinic Cleveland 6, Ohio

The British Delegation proposed that the Constitution of the International Congress of Radiology be amended so that a permanent structure in the nature of an "International Federation of Radiological Societies" be set up, which involved membership and financial support by the various National Radiological Societies. President Paterson appointed a subcommittee to deal with this problem, which felt that the time was too short to deal with the complicated problem of arranging a Constitution and By-laws for a new organization. This subcommittee submitted the following report:

The Sub-Committee has considered the documents circulated to the members of the International Committee, numbered Appendix G and entitled "Constitution and Laws of the International Federation of Radiological Societies."

The Sub-Committee is of the opinion that the time has come to initiate action for the formation of an International Federation of Radiological Societies, but it considers that no detailed proposals can be formulated at this Congress. The Sub-Committee recommends, however, that the delegates to the Sixth International Congress of Radiology should be requested to report this proposal in principle to their own National Radiological Societies, with a view to further discussion at the Seventh International Congress of Radiology at Copenhagen, with the intent that each National Radiological Society shall instruct its delegate to the 7th International Congress to express its opinion on the desirability of the formation of such a federation. It is pointed out that such a proposal involves financial as well as moral support, possibly to the extent of 3 per cent of the collected membership subscriptions or dues.

The Sub-Committee further recommends that, in the meantime, the Constitution of the International Congress of Radiology be amended by the addition of the following paragraphs (the proposed new matter is italicized).

"*The National Board of Management*

20. The President of the Congress shall, in consultation with the delegates from the country where the Congress is to be held, appoint the Board of Management, the General Secretary and all the other officials.
21. The National Board of Management of the Congress shall be entirely responsible for all the Congress arrangements, financial and otherwise."

21a. (I) *For the purposes of securing continuity in the organization of International Congresses, the National Board of Management shall appoint an Executive Secretary who shall be paid from the funds of the Congress.*

(II) *The Executive Secretary shall be appointed two years before the date fixed for the commencement of the next Congress and shall continue to be employed for one year thereafter.*

(III) *During the year following the Congress, it shall be the duty of the Executive Secretary to prepare a detailed report, including a full financial report, on the working and organization of the Congress; to obtain and keep up-to-date lists of the memberships of all National Radiological Societies; to collect all such other information as may be of assistance to the National Board of Management in the organization of the forthcoming Congress; and, on the direction of the Secretary-General, to make recommendations on organization.*

(IV) *The National Board of Managenent shall decide whether it employs the same person as its Executive Secretary as was employed by the previous Congress, or whether it employs a different person. If the National Board of Management employs a different person, it shall provide for the fullest possible consultation and exchange of information between the outgoing and the incoming Executive Secretaries, including a period of overlap, not exceeding six months, in the services of the respective Executive Secretaries.*

Ross Golden, *Chairman*
Hermann Holthusen
Felix Leborgne
P. Flemming Møller

President Paterson stated that the membership fees amounted to less than half the cost of organizing and running the Congress.

An important report was presented by the International Commission on Radiological Protection, on which the United States was represented by Lauriston S. Taylor and Robert R. Newell, and another by the International Commission on Radiological Units, on which the United States was represented by Lauriston S. Taylor, G. Failla, and Robert R. Newell. These reports will be published in detail.

At the request of the Commission on Radiological Protection, the International Committee resolved that this important Commission shall be composed of not more than twelve members, that members shall be elected by the International Executive Committee from a list of nominations submitted by the National Delegations and by the I.C.R.P. itself, that these members shall be chosen on the basis of their recognized activities in the field of radiology and allied sciences without regard to nationality, and that the I.C.R.P. shall be authorized to form subcommittees, including additional individuals selected by itself, for the purpose of dealing with detailed studies in specialized fields.

President Paterson announced that "Le Centre Antoine Béclère des Relations Internationales en Radiologie Médicale" (The Béclère Foundation) had been established in Paris by Antoinette and Dr. Claude Béclère in honour of their father, who was an eminent pioneer French radiologist, President of the Third International Congress of Radiology, and died a martyr to the roentgen ray. Upon the request of Mlle. Antoinette and Dr. Claude Béclère, President Paterson appointed Dr. Arthur

C. Christie, and Professor Gösta Forssell of Stockholm, with Professor Hans R. Schinz of Zürich as alternate, as the unofficial representatives of the International Congress of Radiology on the Board of the Foundation.

Invitations were received from radiological societies in Denmark, Italy and Uruguay to hold the next International Congress in their respective countries. By ballot the International Committee accepted the invitation of Denmark. The National Delegation from Denmark thereupon announced that the meeting would be held in the summer of 1953 in Copenhagen, with Professor Dr. P. Flemming Møller as President.

The British officials had hoped to publish the papers presented in the symposia together so that they would be available in one journal. Because of the problem of translation, this did not seem to be feasible and, consequently, the various writers were requested to have their material published in the journal most convenient to them.

Dr. Arthur C. Christie, Washington, D.C., President of the Fifth International Congress held in Chicago in 1937, was unable to go to London. Many expressions of regret were heard. His genial and sympathetic presence and his wise counsel were greatly missed.

The Closing Ceremonies were held in Central Hall on Friday Afternoon. President Paterson announced that 1,742 radiologists had registered and that the total of regular and associate members, which includes members of radiologists' families, came to 3,364. This was approximately one thousand more than had been anticipated. Fifty-four countries were represented. Medals were presented to Drs. Christie. Forssell, Orndoff, and Schinz, which were replicas of the Presidential Medallion and which were prepared by the British radiologists. Also the British radiologists presented to the International Congress of Radiology a brass bell made in the fifteenth centry, which was used at the opening and the closing ceremonies to "ring in" and to "ring out" the Sixth International Congress of Radiology.

The visitors found that the London taxicab drivers were highly skillful, that the bus conductors were very willing to help the foreigners, and that the "Bobby" had lost none of his proverbial courtesy.

The members of the Sixth International Congress were unanimous in their praise of the superb organization set up by President Ralston Paterson and the other British officials. The Congress was run very well, in spite of the fact that many more visitors attended than were expected.

Following the Congress a number of bus tours were organized to enable the members to visit hospitals in various parts of England and to see the beautiful English countryside. The visitors came away with the impression that the main and highly successful avocation of the English people is the growing of flowers. The beauty of the gardens was surpassed only by the cordiality of British Hospitality.

Ross Golden, M.D.

SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

MEETINGS OF ROENTGEN SOCIETIES*

United States of America

American Roentgen Ray Society
Secretary, Dr. Barton R. Young, Germantown Hospital, Philadelphia 44, Pa. Annual meeting: Jefferson Hotel, St. Louis, Mo., Sept. 26–29, 1950.

American Radium Society
Secretary, Dr. J. E. Wirth, U. S. Marine Hospital, Baltimore, Md. Annual meeting: 1951, to be announced.

Radiological Society of North America
Secretary, Dr. D. S. Childs, 713 E. Genesee St., Syracuse 2, N. Y., Annual meeting: Palmer House, Chicago, Ill., Dec. 10–15, 1950.

American College of Radiology
Executive Secretary, William C. Stronach, 20 N. Wacker Drive, Chicago 6.

Section on Radiology, American Medical Association
Secretary, Dr. Paul C. Hodges, 950 E. 59th St., Chicago, Ill.

Alabama Radiological Society
Secretary, Dr. W. W. Anderson, Tuscaloosa, Ala. Meets time and place Alabama State Medical Association.

Arizona Association of Pathologists and Radiologists
Secretary, Dr. R. Lee Foster, 507 Professional Bldg., Phoenix, Ariz. Two regular meetings a year. The annual meeting at time and place of State Medical Association and interim meeting six months later.

Arkansas Radiological Society
Secretary, Dr. Fred Hames, 511 National Bldg., Pine Bluff, Ark. Meets every three months and also at time and place of State Medical Association.

Atlanta Radiological Society
Secretary, D. W. W. Bryan, 490 Peachtree St., N.E., Atlanta, Ga. Meets monthly, except during three summer months, on second Friday evening.

Brooklyn Roentgen Ray Society
Secretary, Dr. J. J. Daversa, 345 75th St., Brooklyn, N. Y. Meets monthly fourth Tuesday, Oct. through April.

Buffalo Radiological Society
Secretary, Dr. Mario C. Gian, 610 Niagara St., Buffalo, N. Y. Meets second Monday evening each month, October to May inclusive.

Central New York Roentgen Ray Society
Secretary, Dr. Dwight V. Needham, 608 E. Genesee St., Syracuse N. Y. Meets January, May, November.

Central Ohio Radiological Society
Secretary, Dr. F. A. Riebel, 15 West Goodale St., Columbus, Ohio. Meets at 6:30 P.M. on second Thursday of October, December, February, April, and June at Columbus Athletic Club, Columbus, Ohio.

Chicago Roentgen Society
Secretary, Dr. B. D. Braun, 6 N. Michigan Ave., Chicago 2, Ill. Meets second Thursday of each month, October to April inclusive at the University Club.

Cincinnati Radiological Society
Secretary, Dr. E. C. Elsey, 927 Carew Tower, Cincinnati 2, Ohio. Meets last Monday of each month, September to May, inclusive.

Cleveland Radiological Society
Secretary, Dr. J. R. Hannan, 10515 Carnegie Ave., Cleveland 6, Ohio. Meetings at 6:45 P.M. on fourth Monday of each month from October to April.

Colorado Radiological Society
Secretary, Dr. Paul E. RePass, 306 Republic Bldg., Denver 2, Colo. Meets third Friday of each month at University of Colorado Medical Center or at Denver Athletic Club.

Connecticut Valley Radiologic Society
Secretary, Dr. E. W. Godfrey, 1676 Boulevard, West Hartford, Conn. Meets second Friday Oct. and April.

Dallas-Fort Worth Roentgen Study Club
Secretary, Dr. X. R. Hyde, Medical Arts Bldg., Fort Worth, Texas. Meets in Dallas on odd months and in Fort Worth on even months, on third Monday, 7:30 P.M.

Detroit Roentgen Ray and Radium Society
Secretary, Dr. W. G. Belanger, Harper Hospital. Meets monthly on first Thursday from October to May, at Wayne County Medical Society Building.

East Bay Roentgen Society
Secretary, Dr. Dan Tucker, 434-30th St., Oakland 9, Calif. Meets first Thursday each month at Peralta Hospital, Oakland.

Florida Radiological Society
Secretary, Dr. F. K. Hurt, Riverside Hospital, Jacksonville, Fla. Meets twice annually, in the spring with the annual State Society meeting, and in the fall.

Georgia Radiological Society
Secretary, Dr. R. C. Pendergrass, Americus, Ga. Meets in mid-winter and at annual meeting of Medical Association of Georgia in the spring.

Greater Miami Radiological Society
Secretary, Dr. David Kirsh, 712 duPont Bldg., Miami 32, Florida. Meets last Wednesday of each month at 8:00 P.M. at Veterans Administration Regional Office.

Houston X-ray Club
Secretary, Dr. Curtis H. Burge, 3020 San Jacinto St. Houston 4, Texas. Meets fourth Monday each month.

Radiological Society of Kansas City
Secretary, Dr. Arthur B. Smith, 800 Argyle Bldg., Kansas City, Mo. Meets third Thursday of each month.

Illinois Radiological Society
Secretary, Dr. Wm. DeHollander, St. John's Hospital, Springfield, Ill. Meets three times a year.

Indiana Roentgen Society
Secretary, Dr. William M. Loehr, 712 Hume-Mansur Bldg., Indianapolis 4. Meets second Sunday in May.

Iowa X-Ray Club
Secretary, Dr. Arthur W. Erskine, 326 Higley Bldg., Cedar Rapids, Iowa. Luncheon and business meeting during annual session of Iowa State Medical Society. Special meetings by announcement.

Kansas Radiological Society
Secretary, Dr. Anthony F. Rossitto, Wichita Hospital, Wichita, Kan. Meets annually with State Medical Society.

Kentucky Radiological Society
Secretary, Dr. W. C. Martin, 321 W. Broadway, Louisville. Meets annually in Louisville on first Saturday in Apr.

Kings County Radiological Society
Secretary, Dr. Marcus Wiener, 1430-48th St., Brooklyn, N. Y. Meets Kings County Med. Soc. Bldg. monthly on fourth Thursday, October to May, 8:45 P.M.

Los Angeles Radiological Society
Secretary, Dr. Wybren Hiemstra, 1414 S. Hope St., Los Angeles 15, Calif. Meets second Wednesday each month at Los Angeles County Medical Assn. Building.

Louisiana Radiological Society
Secretary, Dr. J. R. Anderson, 1130 Louisiana Ave., Shreveport. Meets annually during Louisiana State Medical Society Meeting.

* Secretaries of societies are requested to send timely information promptly to the Editor.

Louisville Radiological Society
Secretary, Dr. E. L. Pirkey, Louisville General Hospital, Louisville 2, Ky. Meets monthly on second Friday at Seelbach Hotel, Louisville.

Maine Radiological Society
Secretary, Dr. C. F. Miller, Central Maine General Hospital, Lewiston, Maine.

Miami Valley Radiological Society
Secretary, Dr. G. A. Nicoll, 134 Apple St., Dayton, Ohio. Meets second Friday of fall and winter months.

Michigan Association of Roentgenologists
Secretary, Dr. R. D. McDuff, 220 Genesee Bank Bldg., Flint 3, Mich.

Milwaukee Roentgen Ray Society
Secretary, Dr. T. J. Pfeffer, 839 N. Marshall St., Milwaukee 2, Wis. Meets monthly on second Monday at University Club.

Minnesota Radiological Society
Secretary, Dr. L. A. Nash, 572 Lowry Medical Arts Bldg., St. Paul 2, Minn. Meets three times annually, once at time of State Med. Assn., and in spring and fall.

Nebraska Radiological Society
Secretary, Dr. J. E. Downing, 816 Medical Arts Bldg., Omaha, Nebr. Meets fourth Thursday of each month at 6 P.M. at Omaha or Lincoln.

New England Roentgen Ray Society
Secretary, Dr. L. L. Robbins, Massachusetts General Hospital, Boston, Mass. Meets monthly on third Friday, Harvard Club.

New Hampshire Roentgen Ray Society
Secretary, Dr. A. C. Johnston, Elliott Community Hospital, Keene, N. H. Meets four to six times yearly.

New York Roentgen Society
Secretary, Dr. J. L. Olpp, 49 Ivy Lane, Tenafly, N. J. Meets monthly on third Monday, New York Academy of Medicine, at 8:30 P.M.

North Carolina Radiological Society
Secretary, Dr. J. E. Hemphill, 1420 E. Fifth St., Charlotte 4, N. C. Meets in May and October.

North Dakota Radiological Society
Secretary, Dr. C. O. Heilman, 807 Broadway, Fargo. Meetings by announcement.

Northern California Radiological Club
Secretary, Dr. C. W. Wauters, 701 High St., Auburn, Calif. Meets at dinner last Monday, every second month, except June, July and August.

Ohio State Radiological Society
Secretary, Dr. E. C. Elsey, 927 Carew Tower, Cincinnati 2, Ohio.

Oklahoma State Radiological Society
Secretary, Dr. W. E. Brown, 21st & Xanthus, Tulsa 4, Okla. Three regular meetings annually.

Oregon Radiological Society
Secretary, Dr. C. T. Jessell, 214 Medical-Dental Bldg., Portland 5, Oregon. Meets monthly 2nd Wednesday, 8:00 P.M.

Orleans Parish Radiological Society
Secretary, Dr. Joseph V. Schlosser, Charity Hospital, New Orleans 13, La. Meets first Tuesday of each month.

Pacific Northwest Radiological Society
Secretary, Dr. S. J. Hawley, 1320 Madison St., Seattle 4, Wash. Meets annually in May.

Pacific Roentgen Society
Secretary, Dr. L. H. Garland, 450 Sutter St., San Francisco, Calif. Meets annually, during meeting of California Medical Association.

Pennsylvania Radiological Society
Secretary, Dr. J. M. Converse, 416 Pine St., Williamsport.

Philadelphia Roentgen Ray Society
Secretary, Dr. G. P. Keefer, American Oncologic Hospital, Philadelphia 4, Pa. Meets first Thursday each month October to May, at 8:00 P.M., in Thomson Hall, College of Physicians.

Pittsburgh Roentgen Society
Secretary Dr. E. J. Euphrat, 3500 Fifth Ave., Pittsburgh 13, Pa. Meets 6:30 P.M. at Webster Hall Hotel on second Wednesday each month, October to May inclusive.

Queens Roentgen Ray Society
Secretary, Dr. J. E. Goldstein, 88-29 163rd St., Jamaica 3, N. Y. Meets fourth Monday of each month except during the summer.

Radiological Section, Baltimore Medical Society
Secretary, Dr. Harry A. Miller, 2452 Eutaw Place, Baltimore. Meets third Tuesday each month, Sept. to May.

Radiological Section, Connecticut Medical Society
Secretary, Dr. Fred Zaff, 135 Whitney Ave., New Haven, Conn. Meets bimonthly on second Wednesday.

Radiological Section, District of Columbia Medical Society
Secretary, Dr. K. C. Corley, 1835 Eye St., N. W., Washington, D. C. Meets Medical Society Auditorium, third Thursday, Jan., March, May, Oct. at 8:00 P.M.

Radiological Section, Southern Medical Association
Secretary, Dr. Roy G. Giles, Temple, Texas.

Radiological Society of New Jersey
Secretary, Dr. Peter Gianquinto, 685 High St., Newark, N. J. Meets annually at Atlantic City at time of State Medical Society and mid-winter at Elizabeth, N. J.

Rochester Roentgen Ray Society, Rochester, N. Y.
Secretary, Dr. A. V. Winchell, 40 Meigs St., Rochester, N. Y. Meets monthly on last Monday from September through May, 8 P.M. at Strong Memorial Hospital.

Rocky Mountain Radiological Society
Secretary, Dr. Maurice D. Frazer, 1037 Stuart Bldg., Lincoln, Nebr. Meets Shirley-Savoy Hotel, Denver, Colo., Aug. 17, 18, 19, 1950.

St. Louis Society of Radiologists
Secretary, Dr. H. R. Senturia, Pasteur Medical Building, St. Louis, Mo. Meets fourth Wednesday each month, except June, July, August, and September.

San Diego Roentgen Society
Secretary, Dr. R. F. Niehaus, 1831 Fourth Ave., San Diego, Calif. Meets monthly, first Wednesday at dinner.

Section on Radiology, California Medical Association
Secretary, Dr. D. R. MacColl, 2007 Wilshire Blvd., Los Angeles 5, Calif.

Section on Radiology, Illinois State Medical Society
Secretary, Dr. Harold L. Shinall, St. Joseph's Hospital, Bloomington, Ill.

Shreveport Radiological Club
Secretary, Dr. R. W. Cooper, Charity Hospital, Shreveport, La. Meets monthly on third Wednesday, at 7:30 P.M., September to May inclusive.

South Carolina X-Ray Society
Secretary, Dr. S. H. Fisher, 107 E. North St., Greenville, S. C. One meeting with South Carolina Medical Association in May, others arranged by President.

Tennessee Radiological Society
Secretary, Dr. J. M. Frère, 707 Walnut St., Chattanooga, Tenn. Meets annually at the time and place of the Tennessee State Medical Association.

Texas Radiological Society
Secretary, Dr. R. P. O'Bannon. 650 Fifth Ave., Fort Worth 4, Texas. Next meeting, Galveston, Texas, January 19 and 20, 1951.

University of Michigan Department of Roentgenology Staff Meeting
Meets each Monday evening from September to June, at 7 P.M. at University Hospital.

University of Wisconsin Radiological Conference
Secretary, Dr. E. A. Pohle, 1300 University Ave., Madison, Wis. Meets first and third Thursdays 4:00 to 5:00 P.M., September to May inclusive. Room 203, Service Memorial Institute, 426 N. Charter St., Madison.

Utah State Radiological Society
Secretary, Dr. Angus K. Wilson, 343 S. Main St., Salt Lake City 1, Utah. Meets third Wednesday in September, November, January, March and May.

Virginia Radiological Society
Secretary, Dr. P. B. Parsons, Norfolk General Hospital, Norfolk, Va. Meets annually in October.

Washington State Radiological Society
Secretary, Dr. R. C. Kiltz, 705 Medical-Dental Bldg., Everett, Wash. Meets fourth Monday each month, October through May, College Club, Seattle.

Wisconsin Radiological Society
Secretary, Dr. Irving I. Cowan, 425 E. Wisconsin Ave., Milwaukee 2, Wis. Special meetings held during year; annual meeting each spring at Madison, Wis.

X-Ray Study Club of San Francisco
Secretary, Dr. M. A. Sisson, 450 Sutter St., San Francisco, 8, Calif. Meets January to July, Lane Hall, Stanford University Hospital, and July to December at San Francisco Hospital.

Cuba, Mexico and Central America

Sociedad de Radiología y Fisioterapia de Cuba
President, Dr. J. Manuel Viamonte, Hospital Mercedes, Habana, Cuba. Meets monthly in Habana.

Sociedad Mexicana de Radiologia y Fisioterapia
General Secretary, Dr. D. P. Cossio, Marsella No. 11, Mexico, D. F. Meets first Monday of each month.

Sociedad Radiológica Panameña
Secretary, Dr. L. Arrieta Sanchez, Apartado No. 86 Panama, R. de P. Meets monthly in a department of radiology of a local hospital, chosen at preceding meeting.

British Empire

British Institute of Radiology Incorporated with the Röntgen Society
Ordinary meeting, on the Thursday preceding the third Friday, October to May at 8:15 p.m.
Medical Members' meeting, on third Friday in each month at 5:00 p.m., 32 Welbeck St., London, W 1.

Faculty of Radiologists
Honorary Secretary, Dr. J. F. Bromley, 45, Lincoln's Inn Fields, London, W.C.2, England.

Section of Radiology of the Royal Society of Medicine (Confined to Medical Members)
Meets third Friday each month at 4:45 p.m. at the Royal Society of Medicine, 1 Wimpole St., London.

Canadian Association of Radiologists
Honorary Secretary-Treasurer, Dr. Jean Bouchard, Suite 305, 1555 Summerhill Avenue, Montreal 26, Que. Meetings January and June.

Section of Radiology, Canadian Medical Association
Secretary, Dr. C. M. Jones, Inglis St., Ext. Halifax, N. S.

Société Canadienne-Française d'Electrologie et de Radiologie Médicales
Secretary, Dr. Origéne Dufresne, 4120 Ontario St., East, Montreal, P. Q.

Australian and New Zealand Association of Radiologists
Honorary Secretary, Dr. Alan R. Colwell, 135 Macquarie St., Sydney, N.S.W.
Honorary Secretaries, State Branches:
New South Wales, Dr. E. W. Frecker, 135 Macquarie St., Sydney.
Victoria, Dr. T. I. Tyrer, 3 Lockerbie Court, East St. Kilda.
Queensland, Dr. J. Adam, 131 Wickham Terrace, Brisbane.
South Australia, Dr. R. de G. Burnard, 170 North Terrace, Adelaide.
Western Australia, Dr. A. M. Nelson, 179-B St. Georges Terrace, Perth.
New Zealand, Dr. E. G. Lynch, 12 Bolton St., Wellington.

South America

Asociacion Argentina de Radiologia
Secretary, Dr. Lidio G. Mocsa, Avda. Gral Paz 151, Córdoba, Argentina. Meetings held monthly.

Sociedad Argentina de Radiologia
Secretary, Dr. Guido Gotta, Buenos Aires, Argentina. Meetings are held monthly.

Sociedad Argentina de Radiología, Filial del Litoral
President, Dr. Francisco P. Cifarelli. Meets monthly second Wednesday, 7:00 p.m., 663 Italia St., Rosario.

Sociedade Brasileira de Radiologia Medica
Secretary, Dr. Nicola Caminha, Av. Mem de Sa, Rio de Janeiro, Brazil. Meets monthly, except during January, February and March.

Sociedade Brasileira de Radioterapia
Secretary, Dr. Oscar Rocha von Pfuhl, Av. Brigadeiro Luiz Antonio, 644 São Paulo, Brazil. Meets monthly on second Wednesday at 9 p.m. in São Paulo at Av. Brigadeiro Luiz Antonio, 644.

Sociedad Peruana de Radiologia
Secretary, Dr. Julio Bedoya Paredes, Apartado, 2306, Lima, Peru. Meets monthly except during January, February and March, at Asociación Médica Peruana "Daniel A. Carrión," Villalta, 218, Lima.

Sociedad de Radiologica, Cancerologia y Fisica Medica del Uruguay
Secretary, Dr. Arias Bellini.

Continental Europe

Société Belge de Radiologie
General Secretary, Dr. S. Masy, 111 Avenue des Allies, Louvain, Belgium. Meets monthly, second Sunday at Maison des Médecins, Brussels.

Ceskoslovenská společnost pro röntgenologii a radiologii v Praze
Secretary, Dr. Roman Bláha, Praha XII, stát. nemocnice, Czechoslovakia. Meets monthly except during July, August, and September. Annual general meeting.

Polish Society of Radiology
Secretary, Dr. L. Zgliczynski, 59 Nowogrodzka St., Warsaw, Poland.

Gdansk Section, Polish Society of Radiology
Secretary, Dr. A. Smigielska, Akademia Lekarska, Gdansk. Meets monthly last Sunday at 10.30, X-Ray Dept., Akademia Gdansk.

Warsaw Section, Polish Society of Radiology
Secretary, Dr. L. Zgliczynski, 59 Nowogrodzka St., Warsaw, Poland. Meets monthly.

Societatea Romana de Radiologie si Electrologie
Secretary, Dr. Oscar Meller, Str. Banual Mărăcine, 30, S. I., Bucuresti, Roumania. Meets second Monday in every month with the exception of July and August.

All-Russian Roentgen Ray Association, Leningrad. USSR in the State Institute of Roentgenology and Radiology, 6 Roentgen St.
Secretaries, Drs. S. A. Reinberg and S. G. Simonson. Meets annually.

Leningrad Roentgen Ray Society
Secretaries, Drs. S. G. Simonson and G. A. Gusterin. Meets monthly, first Monday at 8 o'clock, State Institute of Roentgenology and Radiology, Leningrad.

Moscow Roentgen Ray Society
Secretaries, Drs. L. L. Holst, A. W. Ssamygin and S. T. Konobejevsky. Meets monthly, first Monday, 8 p.m.

Scandinavian Roentgen Societies
The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association.

Sociedad Espanola de Radiologia y Electrologia
Secretary, Dr. J. Martin-Crespo, Fuencarral, 7. Madrid, Spain. Meets monthly in Madrid.

Schweizerische Röntgen-Gesellschaft (Société Suisse de Radiologie)
Secretary, Dr. Max Hopf, Effingerstrasse 47, Bern, Switzerland.

Societa Italiana di Radiologia Medica
Secretary Prof. Mario Ponzio, Ospedale Mauriziano. Torino, Italy. Meets biannually.

COURSES IN THE TECHNIQUES OF USING RADIOISOTOPES IN RESEARCH

The eighteenth, nineteenth, and twentieth courses in the techniques of using radioisotopes in research will be given by the Special Training Division of the Oak Ridge Institute of Nuclear Studies during the winter and spring of 1951. Dates for the courses are as follows:

January 8–February 2
February 19–March 16
April 16–May 11

The courses are designed to acquaint research workers with the safe and efficient use of radioisotopes in research. The course work consists of laboratory work, lectures on laboratory experiments, general background lectures and special-topic seminars. Experiments are conducted covering the use and calibration of instruments, the purification and separation of radioactive materials from inert and other radioactive materials, measurement and use of Carbon-14, pile activations, radioautographs and the like. Seminars include such topics as the use of radioisotopes in animal experimentation, use of radioisotopes in humans, principles and practice of health physics, designs of radiochemical laboratories, effect of radiation on cells, and similar topics.

The Special Training Division can accommodate thirty-two participants at each of the three courses. A registration fee of $25 is charged, and participants will bear their own living and traveling expenses.

Additional information and application blanks may be obtained from Dr. Ralph T. Overman, Chairman, Special Training Division, Oak Ridge Institute of Nuclear Studies, P. O. Box 117, Oak Ridge, Tennessee.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

The 117th meeting of the American Association for the Advancement of Science will be held in Cleveland, Ohio, December 26–30, 1950. This will be a full-scale meeting, with programs in every principal field of science from anatomy and botany to, and including, zoology. All seventeen of the Association's sections and subsections and more than forty participating societies and organizations are completing plans for a total of more than two hundred sessions. Housing is being taken care of by the Cleveland Convention Bureau, with hotels confirming reservations directly. Announcements and coupons for reservations will be found in *Science* and the *Scientific Monthly*.

SEPTIMAS JORNADAS RADIOLOGICAS ARGENTINAS

The Seventh Argentinian Radiological Meeting (Septimas Jornadas Radiologicas Argentinas) will be held in Rosario, Argentina, November 10, 11 and 12, 1950. The scientific sessions of the meeting will be held at the Circulo Medico de Rosario, under the auspices of the Filial del Litoral of the Sociedad Argentina de Radiologia. The Scientific Program has been arranged by the Executive Committee, headed by Dr. Francisco Pablo Cifarelli, including three central topics: (1) Angiocardiography, (2) Roengen Therapy in Blood Diseases, and (3) Roentgen Study of Abdominal Tumors. Radiologists who are interested in attending the Meeting should communicate at once with Dr. F. P. Cifarelli, 663 Italia St., Rosario, Argentina.

NEW ENGLAND ROENTGEN RAY SOCIETY

The following are the newly elected officers of the New England Roentgen Ray Society for the ensuing year: *President*, Dr. George Levene; *Vice-President*, Dr. Jack Spencer; *Secretary*, Dr. L. L. Robbins; *Treasurer*, Dr. Joseph H. Marks.

PITTSBURGH ROENTGEN SOCIETY

At the meeting of the Pittsburgh Roentgen Society held on June 14, 1950, the following officers were elected for the year 1950–1951: *President*, Dr. Eva S. Carey; *Vice-President*, Dr. Lester M. J. Freedman; *Secretary*, Dr. Edwin J. Euphrat; *Treasurer*, Dr. Alan R. Brown.

RADIOLOGICAL SOCIETY OF NEW JERSEY

At the annual meeting of the Radiological Society of New Jersey held on May 22, 1950, in Atlantic City, New Jersey, the following officers were elected for the year 1950–1951: *President*, Dr. Raphael Pomeranz, Newark, New Jersey; *Vice-President*, Dr. Benjamin Copleman, Perth Amboy, New Jersey; *Secretary*, Dr. Peter J. Gianquinto, Newark, New Jersey; *Treasurer*, Dr. V. M. Whelan, Red Bank, New Jersey.

BOOK REVIEWS

Books sent for review are acknowledged under: Books Received. This must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interest of our readers as space permits.

TOMOGRAFÍA CLÍNICA CARDIO-VASCULAR. Biblioteca del Médico Práctico Vol. XXIX. Por los doctores Juan Govea, Cariólogo—Hospital Mercedes, Habana; y Fidel Aguirre, Radiólogo—Instituto del Radiums, Hospital Mercedes, Habana. Cloth. Price, $8.00. Pp. 482, with 308 illustrations. Cultural, S. A., 525 Obispo Street, Habana, Cuba, 1949.

This is volume 19 of the Library of Medical Practice published by Cultural, S. A., Havana, Cuba, and is the first book of this size dedicated to the tomographic method as applied to cardiovascular pathology. As a matter of fact, the authors do not limit themselves to the tomographic study of different cases, but present an interesting study of the anatomic, roentgenologic, and tomographic aspects of the heart and the principal blood vessels.

In each chapter the cardiovascular pathology is carefully correlated with the clinical viewpoint as well as the roentgenologic view in general and the tomographic view in particular. Thus the authors have originated some truly interesting roentgenologic and tomographic syndromes.

The text is illuminated by many illustrations, which the reviewer thinks are rather well done considering that most of them are tomograms.

In their final words, the authors recognize the high cost of tomography and have promised early the production of an apparatus for tomographic fluoroscopy (tomo-fluoroscopía) which may be applied to the current system of fluororoentgenography, and which will permit the use of films of small size.

JAMES T. CASE, M.D.

DIE DURCHLEUCHTUNGSTECHNIK DER THORAXORGANE. By E. A. Zimmer, Privatdozent an der Universität Basel und Chefarzt des Röntgeninstitutes und des Institutes für Physikalische Therapie im Hôpital Cantonal Fribourg. Second enlarged edition. Cloth. Price, Swiss Fr. 12.50 bound. Pp. 119, with 66 illustrations. Benno Schwabe & Co., Ver. lag, Klosterberg 27, Basel, Switzerland, 1949.

Physicians enrolled in the postgraduate courses and medical students suggested to the author that he prepare a brief manual outlining the technique of chest roentgenoscopy. The first edition published in 1946 was exhausted within a year and necessitated the preparation of this second only slightly revised edition.

The fundamental technical aspects of the roentgenoscopic examination of the thorax and its organs are briefly discussed; a study of the abdomen should precede the examination of the chest just as a screening of the chest should precede any gastrointestinal study. Rare abnormalities are omitted; only typical pathology is described in topographical order so that the book can be most useful to the physician in general practice. The localization of foreign bodies is briefly mentioned. In a supplement, illustrations of some of the apparatus used in Switzerland are shown. Although the author urges a wider use of chest roentgenoscopy by the general practitioner, he is very emphatic in stating that this method must never be considered a substitute for chest roentgenography. He also urges consultation with the radiologist before establishing the final diagnosis. This little book gives a concise and accurate introduction to the art of chest roentgenoscopy.

ERNST A. POHLE, M.D.

RADIOLOGIA SCHERMOGRAFICA. By Franco Fossati, L. D. di Radiologia nell' Univ. di Milano; and Patrizio Gallone, Dottore in Fisica. Cloth. Price, Lire, 3000. Pp. 387, with 157 illustrations. Milano: Garzanti, 1949.

This book is an attempt to present all phases and aspects of fluorophotography in one work of comprehensive character. As such, the book is a very successful undertaking. The authors devote 114 pages to the history, apparatus, technique, and physics of fluorophotography, 52 pages to the optics involved, 73 pages to the production of photographic images and to the technique of processing the films, 12 pages to the interpretation of roentgenograms, and 13 pages to the organization of a fluorophotographic section. Appendices deal with the voltages to be found in various Italian provinces,

the use of logarithms in connection with fluorophotography, and there is even a five language dictionary of fluorophotographic terms covering 31 pages. The bibliography occupies the next 22 pages, and a very good index finishes the book.

This is a very complete book in the old European Manner. Although it is questionable that anyone would want to be familiar with all the subjects covered by the authors, this book may be a valuable source of reference for those interested in the fine points of fluorophotography. The book is clearly written, well printed, and well illustrated.

Cesare Gianturco, M.D.

An Atlas of Myelography. Prepared for the Registry of Radiologic Pathology, American Registry of Pathology, National Research Council, from Material in the Files of the Neurological Institute of New York. By Ernest H. Wood, Jr., M.D., Assistant Professor of Radiology in the College of Physicians and Surgeons, Columbia University; Assistant Attending Radiologist to the Presbyterian Hospital in the City of New York. Cloth. Pp. 111, with numerous illustrations. Registry Press, Washington, D. C., 1948.

This monograph is divided into seven sections as follows:

I. The Technique of Myelography.
II. The Normal Myelogram.
III. Some Technical Errors of Myelography.
IV. Spinal Cord Tumors.
V. Lesions of the Intrathecal Spaces.
VI. Extradural Lesions of the Vertebral Canal.
VII. The Differential Diagnosis of Myelography.

The discussions are brief but pertinent and the illustrations excellent. Each case report includes a concise summary of the history, the physical and neurological changes. In each the roentgen findings during myelography together with gross and microscopic abnormalities demonstrated in excised tissues are outlined.

The author fully realizes that all lesions detectable by myelography are not included but the Atlas contains much useful information. It constitutes an excellent guide for physicians interested in myelography and will be of distinct aid to those making a detailed study of this subject.

Joseph C. Bell, M.D.

Urological Aspects of Spinal Cord Injuries. By George C. Prather, M.D., Department of Genito-Urinary Surgery, Harvard Medical School, Boston, Massachusetts. Cloth. Price, $3.75. Pp. 146, with 42 illustrations. Charles C Thomas, Publisher, 301 East Lawrence Avenue, Springfield, Illinois, 1949.

This concise, yet comprehensive monograph of 143 pages reviews the significant literature on urologic aspects of spinal cord injuries and summarizes a vast personal experience during the World War II.

After discussing the normal anatomy and physiology of the urinary bladder, the various pathologic states resulting from dysfunction of the nervous system are presented and the three states of vesical recovery are considered. A practical diagnostic approach, including the fundamentals of cystometry, completes the reader's orientation.

The objectives of any therapeutic regimen are set forth as ambulation, freedom from infection and efficient emptying of the bladder. The various methods of bladder care (i.e., nondrainage, intermittent catheterization and constant drainage) are compared critically. Rational applications of suprapubic cystostomy and perineal urethrostomy are discussed. Several types of tidal drainage are included in the 42 well planned illustrations.

Changes in the upper urinary tract and in the sexual organs, as well as the common complications of neurogenic bladders, complete the general picture of these problem cases.

The author concludes with an outline of his own preferred program for treatment—a fitting climax to an excellent presentation that should be a "must" for anyone who elects to treat such patients.

Ormond S. Culp, M.D.

Die Röntgendiagnostik der Wirbelsäule und ihre Grundlagen. Von Dr. Med. Adolf Liechti, Professor für Medizinische Radiologie, Direktor des Röntgeninstitutes der Universität Bern. Zweite, neubearbeitete und ergänzte Auflage. Paper. Price, $13.00. Pp. 364, with 234 illustrations. Springer-Verlag, O.H.G., Mölkerbastei 5, Wien 1, Germany, 1948.

The author completed the manuscript for the second edition of his book in 1946; since

his untimely death did not permit him to see the finished volume, one of his pupils, A. Eggli, took over the task of proof reading.

The introductory chapter deals with the development and comparative anatomy of the spinal column; this is followed by a review of the abnormalities and variations seen in that part of the skeleton. A large portion of the text is devoted to a thorough discussion of the numerous diseases of the spine; here the author uses a very effective system of subheading the subject matter. He begins with a description of degenerative changes, followed by an outline of pathologic conditions largely limited to the spine in children and the young. Other subheadings include diseases due to loss of calcium not limited to the spine alone; entities due to an excess of calcium, disturbances in growth, changes in connection with diseases of the blood, inflammatory diseases not limited to the spine, localized infections, tumors of the spine (benign and malignant), pathologic conditions of the spine due to disease processes outside of it, and deviations from the normal curvature. In a last section traumatic changes in the spinal column are fully described.

The illustrations are well chosen and most instructive. The author did not limit these to roentgenograms of the living but freely uses those taken of anatomical preparations and also shows sections of the actual bone side by side with the roentgenograms.

The bibliography covers the literature thoroughly and an attempt has been made to include all recent references available to the author; its completeness is impressive: it comprises almost 100 pages in small print. A well prepared table of contents and an index facilitate orientation.

Every radiologist who can read scientific German reasonably well cannot but profit by the study of this outstanding work of the late Professor Liechti.

Ernst A. Pohle, M.D.

The 1949 Year Book of Radiology—(June 1948–June, 1949). Radiologic Diagnosis edited by Fred Jenner Hodges, M.D., Professor and Chairman, Department of Roentgenology, University of Michigan; and John Floyd Holt, M.D., Associate Professor, Department of Roengenology, University of Michigan. Radiation Therapy edited by Isadore Lampe, M.D., Associate Professor, Department of Roengenology, University of Michigan. Cloth. Price, $6.50. Pp. 453, with 393 illustrations. The Year Book Publishers, Inc., 200 East Illinois Street, Chicago 11, Illinois, 1949.

The Year Book of Radiology continues to be of outstanding importance in the library of the radiologist and of others interested in the subject. Hodges, Holt and Lampe are continuing the good work carried on so successfully for many years by their predecessors, Waters, Kaplan and Firor.

The fact that the book published in 1949 necessarily represents only a part of the literature of 1949 and must review much that was missed in 1948 should not impair its quality.

Radiologists themselves through the medium of their specialty journals and by contribution to other periodicals provide an inexhaustible source of material for each Year Book and the interesting articles in this 1949 book prove that radiology is in the vanguard of the rapidly advancing forces of medical science.

Everyone must be intrigued by the twenty questions propounded on the cover. Whether or not the publishers had in mind the popular radio version of the old parlor game these questions would provide diversion for a group of radiologists and it is fairly certain few would answer a major percentage of them without having digested this Year Book.

Advances in the diagnostic field in 1948 and 1949 are numerous. Amplification and intensification of the image on the fluoroscopic screen, which technical developments give promise of greatly increasing the value of direct observation of normal and pathologic functions.

In angiocardiology diagnostic procedures with ingeniously devised equipment and technique have done much to increase general knowledge and more widespread use of procedures of life-saving significance.

In each of the diagnostic sections on the head, spine and extremities, the chest, the gastrointestinal and genitourinary tracts there is a wealth of practical material well illustrated along with a number of reports of rare and interesting cases.

Radiation therapy has been well covered by Lampe. The abstracts include articles on physics, biology, technique and general clinical considerations as well as specific fields of therapy such as malignancies of various organs and tracts. There are also references to treatment

of infections and to the common affections of obscure etiology—so-called spondylitis, bursitis and the like.

Throughout the book are a moderate number of editorial notes or criticisms of the articles abstracted. These are usually apropos and give the reader help in evaluating what he reads. The comments of Lampe seem to this reviewer particularly stimulating. Such comments are valuable especially to younger students who may not yet have developed a healthy skepticism which prevents them from accepting as established fact anything which appears in print. It helps them acquire the habit of appraising what they read, and separating the small amount of wheat from the abundance of chaff in the multitude of present day publications. Indeed this is the major function of a year book and it is well performed in *The 1949 Year Book of Radiology*.

E. Walter Hall, M.D.

Aktuelle Probleme der Pathologie und Therapie. Herausgegeben von Prof. Dr. H. Holthusen, Hamburg. Cloth. Price, DM 29.— Pp. 248, with 49 illustrations. Georg Thieme, Dimershaldenstrasse 47, Stuttgart, Germany, 1949.

On October 30, 1948, the General Hospital of St. George in Hamburg commemorated the 125th anniversary of its opening. For this occasion a series of 23 papers dealing with a variety of medical subjects was prepared under the editorship of the chief of the medical staff, H. Holthusen, and they are presented in this volume. Two of the contributions are of special interest to the radiologist. One, a paper by Gauwerky and Lindemann, deals with the roentgenological study of the parotid gland after injection of a contrast medium (40 per cent jodipin oil). The value of sialography in the diagnosis of tumors of the parotid, fibrosis following irradiation, inflammatory processes, and in the differential diagnosis of swellings of the parotid of unknown origin is briefly discussed. In the other paper Holthusen and Gauwerky analyze the results obtained by irradiation in gynecological carcinoma. The authors point out that the role of radiation therapy in female genital carcinoma is not the same in all locations. Carcinoma of the ovary is still largely a surgical problem and the same probably holds true for carcinoma of the vulva. In the latter, electrocoagulation should be given serious consideration. In carcinoma of the fundus it is generally conceded that hysterectomy offers better permanent results than irradiation alone, while in carcinoma of the cervix, the vagina, and the female urethra, radiation therapy is predominant. Their survival rate in carcinoma of the cervix is certainly at least as good as that claimed for surgical procedures, and in carcinoma of the fundus irradiation may approach the five year surgical survival rate, especially since the introduction of the "packing technique" developed by Heyman at the Radiumhemmet.

Holthusen's address given at the memorial meeting is reprinted in a supplement. He briefly reviews the history of the institution, points to the destruction caused by the war, and expresses the hope that a lasting peace will make possible not only restoration but improvement of the hospital's service to its patients.

Ernst A. Pohle, M.D.

Vol. 64, No. 4

ABSTRACTS OF RADIOLOGICAL LITERATURE

Department Editor: T. Leucutia, M.D., Harper Hospital, Detroit 1, Michigan

INDEX TO ABSTRACTS

ROENTGEN DIAGNOSIS

Head

Begley, J. W., Jr., and Hallberg, O. E.: Osteomas of the paranasal sinuses and their treatment 671
Torgersen, J.: Roentgenological study of metopic suture 672
Cevese, P. G., and Braggion, P.: Tumors of the forehead and hairy scalp 672
Riese, M. W.: Craniopharyngioma in a woman aged fifty-seven 673
Rand, C. W., and Andler, M.: Tumors of the brain complicating pregnancy 674
Tucker, H. St. G., Jr., Chitwood, J. L., and Parker, C. P., Jr.: Pituitary myxedema 674
Howarth, J. C., and Bunts, A. T.: Intracranial meningioma following trauma 675
Wise, R. E., and Geist, R. M., Jr.: Arteriography in cerebral arteriovenous malformation 675
MacDonald, I.: Combined radical cervicofacial procedures for primary facial cancer 676

Neck and Chest

Corbett, A. J., and McClintock, J. C.: Tumor of carotid body associated with nodular goiter 676
Esser, C.: On the different behavior of different segments of the lungs 676
Jackson, C.: Bronchial obstruction 677
Laivaag, K.: Bronchiogenic carcinoma 677
Woolner, L. B., and McDonald, J. R.: Cytologic diagnosis of bronchogenic carcinoma 678
Rienhoff, W. F., Jr.: Clinical analysis and follow-up study of five hundred and two cases of carcinoma of the lung 678
Meyer, J. H.: Pulmonary alveolar adenomatosis 679
Spain, D. M., and Thomas, A. G.: Pulmonary manifestations of scleroderma 679
Edwards, H. R., and Drolet, G. J.: Implications of changing morbidity and mortality rates from tuberculosis 679
Katz, J., and Plunkett, R. E.: Prevalence of clinically significant pulmonary tuberculosis among inmates of New York State penal institutions 679
Levitin, M., and Zelman, M.: Excisional surgical treatment of pulmonary tuberculosis in children 680
Hartweg, H.: On Boeck's disease of the lungs 680
Overholt, R. H., Ramsay, B. H., and Meissner, W. A.: Intrathoracic pheochromocytoma 681
Cassel, M. A., Cunningham, B. T., and Weisel, W.: Foregut cyst of mediastinum 681
Kunstadter, R. H., Milzer, A., and Whitcomb, F.: Bronchopulmonary geotrichosis in children 681
Torgersen, J.: Developmental anatomy of the heart and the etiology of congenital heart disease 682
Teilum, G., and Madsen, V.: Contribution to the pathogenesis of endometriosis 682
Lynxwiler, C., and Wells, R. C.: Patent ductus arteriosus 682
Nohrman, B. A.: Spontaneous regression of pleural carcinosis in breast cancer 683
de Carvalho, L.: Angiocardiopneumography. 684
Steinberg, I., Dotter, C. T., and Andreus, W. DeW.: Angiocardiography in thoracic surgery 686
Gordon, A. J., Brahms, S. A., and Sussman, M. L.: Visualization of coronary circulation during angiocardiography 686
Green, H., and Apley, J.: Study of cardiac enlargement in infancy with case reports of reversible enlargement 687
Stauffer, H. M., and Rigler, L. G.: Dilatation and pulsation of left subclavian artery in roentgen-ray diagnosis of coarctation of aorta 687
Douzelot, E., Emam-zade, A., Heim de Balsac, R., and Metianu, C.: Some considerations on lévocardia and presentation of two cases 687
Chi, P. S. H., and Adams, W. E.: Benign tumors of esophagus 688
Coodley, E. L.: Pulmonary abscess as complication of hiatal hernia 688
Simonetti, M.: Discussion of roentgen aspects of some cases of extrapleural pneumothorax 688
Meyler, L., and Huizinga, E.: Temporary high position of diaphragm 688

Abdomen

Ask-Upmark, E., and Frantzell, A.: On the pathophysiology of a peculiar syndrome of acute abdominal distension 689
Gianturco, C.: Fast radiological visceral survey 689
Cesarani, F.: Roentgen findings in ulcerated neoplasms of stomach 690
Clay, R. C.: Evaluation of gastrostomy for malignant disease 690
Shanks, S. C.: Problems in x-ray diagnosis of cancer of stomach 690
Palmer, E. D.: Tuberculosis of the stomach and the stomach in tuberculosis 691
Zettergren, L.: Does any genetic connection exist between pyloric hypertrophy in infants and in adults? 691
Sachs, A. E.: Extrinsic duodenal obstruction in newborn 692
Köhler, R.: Prolapse of redundant gastric mucosa into the duodenum 692
Forrester-Wood, W. R.: Giant hypertrophic gastritis 693
Melamed, A.: Etiology and pathogenesis of prolapsed gastric mucosa into the duodenum 693
Cattell, R. B., and Ludwig, J. P.: Premalignant lesions of ampulla of Vater ... 694
Cantor, M. O.: Physics in intestinal intubation 694
Kositchek, R. J., and Rabwin, M. H.: Massive resection of small bowel for adenocarcinoma of jejunum 694
Fleischner, F. G., and Bernstein, C.: Roentgen-anatomical studies of normal ileocecal valve 695
Lowe, C. U., *et al.*: Fibrosis of pancreas 695
Bigelow, R., and Clark, D. E.: Heterotopic pancreatic tissue and gastric mucosa in Meckel's diverticulum 696
Åkerlund, Å., and Rudhe, U.: Intramural small-cystic diverticulosis of the gallbladder 696
Chiray, M., Debray, C., and Delattre, P.: Biliary lithiasis in young individuals 696
Cocchi, U.: Non-filling of the gallbladder 696

Gynecology and Obstetrics

Granjon, A., and Beau, A.-M.: Concerning so-called angular pregnancy 697
Jeaffreson, B. L., and Nathan, N. J. S.: Secondary abdominal pregnancy 698
León, J., and Obiglio, J. R.: Double monster. 698
Anderson, A. F.: Diagnosis of early carcinoma of the cervix uteri and its implications 698

Genitourinary System

Orkin, L. A.: Evaluation of the merits of cystoscopy and retrograde pyelography in the management of renal trauma 699
Musiani, U., and Pollastri, S.: On the lethargy of the kidney 699
Thorsen, G.: Pyelorenal cysts 700
Israels, S., Muth, H., and Zeavin, I.: Nephrolithiasis with renal tubular failure 700
Gaudin, H.: Fatal embolism following urethrography 701
Jackson, A., *et al.*: Renal osteodystrophy associated with diabetes mellitus 701
Griffiths, W.: Carcinoma of the adrenal cortex 702
Guastad, V., and Hertzberg, J.: Acute necrosis of renal papillae in pyelonephritis 702
King, J. D.: Spontaneous renoduodenal fistulas 702
Mitchell, G. A. G.: The renal fascia 702
Lowsley, O. S., and Gentile, A.: Urethral calculus in the male 703
Carp, I. J., and Jacobson, M. B.: Primary carcinoma of ureter 703
Abrahamsen, H.: Ureterovesicostomy as a treatment of congenital stenosis of lower part of ureter 704
Abeshouse, B. E., Goldstein, A. E., and Tankin, L. H.: Ectopic ureteral orifice ... 704
Wells, C.: Studies in chronic retention 705
Howard, H. H., and Holtham, W. H.: Epidermoid carcinoma of penis 705

Nervous System

Elvidge, A. R., and Baldwin, M.: Clinical analysis of eighty-eight cases of metastatic carcinoma involving the central nervous system, with an outline of therapeutic principles 706
Albertengo, J. B.: Medullary compression by Hodgkin's disease 707
Fullenlove, T. M.: Venous intravasation during myelography 707

Skeletal System

Josephs, S.: Growth of the foetal biparietal diameter during the last four weeks of pregnancy 707
Merchán, M., Gimena, J., and Gálvez Armengaud, F.: Multiple metaphyseal dysplasia 708
Evans, F. G., Alfaro, A., and Alfaro, S.: Unusual anomaly of the superior extremities in a Tarascan Indian girl 708
Ragan, C.: General management of rheumatoid arthritis 708
Ellman, P.: Morquio-Brailsford's disease simulating the arthritic manifestation of rheumatoid disease 709

Desmarais, M. H. L.: Neutral 17-ketosteroids in rheumatoid arthritis and spondylitis 709
Alyea, E. P., and Rundles, R. W.: Bone marrow studies in carcinoma of the prostate 709
Maróttoli, O. R., and Didier, A. E.: Homologous graft of preserved bone 710
Marcozzi, G.: Initial roentgenographic signs of coxitis in children (a little known sign for early diagnosis) 710
Sachs, M. D., McGaw, W. H., and Rizzo, R. P.: Studies in the scope of pneumoarthrography of the knee as a diagnostic aid 711
Krainin, P., D'Angio, C. J., and Smelin, A.: Multiple myeloma with new bone formation 711
Muri, J.: Diabetic arthropathy and intercapillary glomerulosclerosis 711
Noyez, D.: Syndrome of fibrous dysplasia 712
Dos Santos, R.: Arteriography in bone tumours 712
Wildervanck, L. S.: Hereditary congenital abnormalities of elbows, knees and nails in five generations 712
Abbott, O. D., *et al.*: Carpal and epiphysial development 713
Stronge, R. F., and McDowell, H. B.: Case of Engelmann's disease 713
Bingold, A. C.: Engelmann's disease 713
Cocchi, U.: Polytopic hereditary enchondral dysostoses 714
Hernberg, C. A., and Edgren, W.: Looser-Milkman's syndrome with neurofibromatosis Recklinghausen and general decalcification of the skeleton 714
Martens, E.: Difficulties of differential diagnosis in tuberculosis of knee joint in children 715
Kneidel, J. H., Smith, L. A., and Bishop, R. E.: Unilateral tuberculous abscess of thoracic spine with roentgen findings of a dumb-bell neurofibroma 716
Guerreiro, G.: Lateral roentgenographic examination of thoracic spine 716
Arkin, A. M.: Mechanism of rotation in combination with lateral deviation in normal spine 716

Blood and Lymph System

Carroll, D. S., and Evans, J. W.: Roentgen findings in sickle-cell anemia 716
Stout, A. P.: Hemangiopericytoma 717
Antoni, N., and Lindgren, E.: Steno's experiment in man as complication in lumbar aortography 717

General

Dahlin, D. C.: Amyloidosis 718
Guardabassi, L.: Contribution to the study of the Besnier-Schaumann-Boeck syndrome 718
Bamatter, F., and Babaiantz, L.: Roentgenologic semeiology of toxoplasmosis and histoplasmosis 719
Looney, J. M., and Stein, T.: Coccidioidomycosis 720
Berke, R., Schomer, A., and Bass, H. E.: Residual cavities in pulmonary coccidioidomycosis 720

RADIOISOTOPES

Hahn, P. F., and Carothers, E. L.: Use of radioactive colloidal metallic gold in the treatment of malignancies 720
Bernier, J. L.: Effects of atomic radiation on the oral and pharyngeal mucosa 721

MISCELLANEOUS

Williams, Katherine: Discussion on the physical, cytological and medical aspects of protection from ionizing radiations with special reference to the use of high voltage X-rays and radioisotopes 721
Marley, W. G.: Physical methods of achieving protection for high energy radiation and radioactive isotopes 722
Skaggs, L. S.: Depth dose of electrons from the betatron 722

ROENTGEN DIAGNOSIS

HEAD

Bègley, Joseph W., Jr., and Hallberg, Olav E. Osteomas of the paranasal sinuses and their treatment. *Proc. Staff Meet., Mayo Clin.*, Jan. 4, 1950, *25*, 13–16.

Of 51 patients with osteoma of the paranasal sinuses, 36 were males and 15 females; the average age was thirty-seven years (10–79 years were the extremes); the slow progression of the condition was evident from the 3.7 year average duration of symptoms; 40 arose from the frontal, 9 from the ethmoid, and 2 from the maxillary sinuses—none from the sphenoid sinuses.

Twenty-seven of the 40 frontal sinus osteomas had extended into neighboring structures: ethmoid sinuses, floor of the orbit, opposite frontal sinus, nasal cavity or antrum, and

through the anterior or posterior walls of the sinus involved. The most common symptoms were frontal pain, then profuse nasal discharge and periorbital swelling even to displacement of the eyeball with diplopia.

Ethmoid osteomas involved neighboring structures early and were all symptomatic earlier than frontal osteomas. Symptoms of intracranial involvement occurred in one case.

The etiology of osteomas of the paranasal sinuses is controversial. Three main pathologic types are the compact, spongy, and mixed.

Surgical removal was the only treatment; small, asymptomatic osteomas were not treated, but merely kept under observation.—*H. G. Moehring, M.D.*

Torgersen, Johan. A roentgenological study of the metopic suture. *Acta radiol.*, Jan., 1950, *33*, 1–11.

One must differentiate between the metopic suture which reaches from the glabella to the bregma and the metopic fissure which represents the remnant of the metopic fontanelle. The metopic suture is the persistent mediofrontal suture which ordinarily closes before the age of two years.

A series of roentgenograms of skulls from the Anthropological Institute showed that the completely persistent metopic suture is not visible in the roentgenogram if the inner table is closed and if there is no sclerosis along the suture. The obliteration of the inner table takes place before the obliteration of the external table.

In 778 skull roentgenograms of the present population of Oslo, the frequency of a persistent metopic suture was found to be 7.2 per cent. The suture is more visible in some age groups than in others. Thus it is seen relatively often in males between twenty and thirty years of age and in females between thirty and fifty years of age. This is probably caused by hyperostosis of the frontal bone which makes the suture more easily visualized at certain ages.

In the metopic skull the sutures usually close late and in these skulls there are apt to be other abnormal sutures. The shape of the forehead and face is established in the period in which the mediofrontal suture is present. Even a slight delay influences the shape of the skull. Thus, in congenital myxedema, the shape of the forehead and face can serve as an illustration of a persistent metopic suture which, as already pointed out, tends to close later than average. Also the frontal sinuses are small in the persistent metopic suture as they are in the cretin.

In 4 of 8 cases of congenital hypothyroidism the suture was found to be present (in individuals over eight years of age). Other observations have shown that the metopic suture tends to persist in congenital myxedema. On the other hand, there seems to be no relationship between hydrocephalus and metopism. There is no higher incidence of the suture's persistence in mentally retarded children. With the one exception of congenital myxedema, there is no evidence of a correlation between the metopic suture and maldevelopment or disease.

The metopic suture deviates more often to the right than to the left. For this reason the radiologist may get the false impression that a correct frontal picture is somewhat oblique.

As well as showing small frontal sinuses, the metopic skull has poorly developed superciliary ridges and rather thin bones. The metopic skull and the typical acromegalic skull represent opposite extremes concerning the reactivity of the tissues to the growth hormones of the pituitary.

Experiments have shown that the place of the sutures is determined by the connective tissue underlying the bone and by factors outside the skull which integrate the development of the brain, the braincase and the organism. —*Mary Frances Vastine, M.D.*

Cevese, P. G., and Braggion, P. Sui tumori della fronte e del cuoio capelluto. (Tumors of the forehead and hairy scalp.) *Arch. radiol.*, Dec., 1949, *25*, 10–32.

This article is based upon 44 cases of epithelioma of the forehead and hairy scalp seen between 1932 and 1948. While these represent only 15 per cent of the facial epitheliomas, they are considered separately because of clinical features of ulceration, bone invasion and post-irradiation ulcer.

The greatest incidence was between the ages of fifty and eighty, and women were afflicted in 60 per cent of the cases. Contributory causes were trauma, especially sunburn, brushing and combing the hair, and premalignant keratosis. The forehead and the temporo-frontoparietal area were most frequently involved. The lesions tended to invade deeper structures and spread to the local lymphatics with 28 per cent of the cases showing either type of extension.

Pain was a common symptom when the underlying tissue, particularly bone, was involved. Seven cases presented bone involvement showing roentgen evidence of osteolysis, demineralization or thinning of bone. Ulceration occurred in 39 of the 44 cases and was frequently associated with infection. These are all factors which adversely influence the response to therapy.

Biopsy was done routinely to establish the degree of malignancy. The diagnosis was usually apparent by inspection, but occasionally a luetic granuloma was confusing.

The treatment was primarily by radiotherapy. Radium was preferred for squamous cell carcinoma, which in contrast to the findings of others was the more common type in these locations. It was distributed either about the periphery or in a palisade arrangement, depending on the size of the lesion. One millicurie destroyed per square centimeter of lesion was considered cancerocidal. Both molds and needle implants were used.

Roentgen therapy was preferred for basal cell carcinoma. The total dose ran from 3,000 to 7,200 r (in air), averaging 4,500 r, and being given in daily fractions. In some instances, two treatments were given without filter, two with 2 mm. of Al and two with 0.5 mm. Cu plus 1 mm. Al filters.

Roentgen therapy was also used in conjunction with radium or surgery, and was valuable in treating incurable lesions or inoperable metastases.

Surgery was largely confined to radical neck dissections or sequestrectomy in instances of necrosis of bone.

The treatment varied with each case so that in this series, 4 had surgery, 13 had mixed surgery and radiotherapy, 15 had roentgen therapy, 13 had radium molds, and 12 had radium needle implants. Treatment was occasionally followed by late radiation ulcer and radionecrosis of the skull. The intense secondary radiation occurring in irradiated bone due to its great density was responsible for the overdosage causing bone necrosis, since in the 5 cases in which this developed, none had skin doses which were excessive. Roentgenograms were valuable in indicating the progress of such lesions and aided in management.

The results are of limited value since none of the cases were observed over three years and many were observed for a lesser period. Twenty-eight of the 44 cases are considered as "cured"; 4 were cured but died of other causes; 7 died with disease and 5 were lost to follow-up.—*C. Colangelo, M.D.*

Riese, M. W. Craniopharyngiome chez une femme âgée de 57 ans. Hallucinations visuelles et auditives. Deuzième note sur la genèse des hallucinations survenant chez les malades atteints de lésions cérébrales. (Craniopharyngioma in a woman aged fifty-seven. Visual and auditory hallucinations. Second communication on the genesis of the hallucinations occurring in patients afflicted with cerebral lesions.) *Rev. neurol.*, Feb., *1950*, *82*, 137–139.

The author briefly reports the case of a woman who at the age of fifty-seven developed a transitory weakness of both legs, somewhat more pronounced on the right side. Six months later she presented the first mental symptoms. She pretended to see Indian chiefs and serpents and on one occasion she called the police to save her from an Indian chief who was pursuing an unknown patient in her home. She described the voice and cries of the Indian chief in great detail. All efforts to dissuade her of her hallucinations remained futile.

Clinical examination revealed the following findings: left homonymous hemianopsia; loss of memory and orientation, apathy, social indifference and complete disregard of customary manners; excessive thirst and appetite; gain in weight; somnolence; bilateral choked discs, more marked on the right side; presence of Hoffmann's sign on both sides; in the later stage, euphoria, incoherent speech and certain induced hypertonic movements.

The spinal fluid showed marked increase of proteins. Ventriculography and electroencephalography remained negative.

After one year the patient died. At postmortem examination a cystic tumor was found in the subthalamic region with pressure on the chiasm and crura of the optic nerve. The tumor had invaded especially the right hemisphere but the thalamus was intact. Microscopic study revealed the tumor to be a typical craniopharyngioma.

In interpreting the mental findings in this case, the author states that it is the first time that visual and auditory hallucinations have been observed in a craniopharyngioma affecting an adult. Lhermitte distinguishes between hallucinations secondary to alterations of the occipital lobe and hallucinations of peduncular

origin. In the author's case it appears doubtful that the pressure on the optic nerve was to any extent responsible for the visual hallucinations since the effect was mostly paralyzing and not stimulating. Furthermore, such assumption would leave the auditory hallucinations unexplained. It is more probable that both hallucinations are the result of a collapse of the opposing resistance of the nerve structures. The sphere or cerebral localization of this resistance is unknown. It may be conceived as extending beyond the true perceptive spheres affecting the entire brain or even the whole organism. Therefore, hallucinations, as in the present case, may result from cerebral lesions situated in the most diversified regions.—*T. Leucutia, M.D.*

Rand, Carl W., and Andler, Maxwell. Tumors of the brain complicating pregnancy. *Arch. Neurol. & Psychiat.*, Jan., 1950, *63*, 1–41.

The usual questions that are raised when pregnancy and serious disease are coincidental are asked about saving mother, or child, and how. The type of brain tumor adds to the complications. An attempt to answer the questions is made by using case histories and reports from the literature.

The symptoms of brain tumor are often confused with symptoms of toxemia of pregnancy. Twelve cases are reported. The first 3 patients died quickly before anything could be done. Diagnosis proved to be astrocytoma. The fetuses were lost. The fourth case was an acoustic neurofibroma discovered after delivery and successfully removed. The fifth case had two normal pregnancies with a known meningioma of the sphenoidal ridge. This tumor was removed some months after the normal termination of the second pregnancy. The pregnancies did not seem to accelerate this growth. The sixth case had had removal of syrupy, yellow fluid from a right cerebellar cyst (probable astrocytoma). Five years later she had a normal child. Seven years after childbirth she had mild recurrence of symptoms. Case 7 had drainage of cyst in left parieto-occipital region. She had a normal child about fourteen months later. Four months after the childbirth symptoms recurred and another exploration disclosed an astrocytoma which was partially removed. Case 8 presented symptoms of a pituitary tumor at about the seventh month of a second pregnancy. The delivery was normal. Roentgen therapy was given and the patient has been well for fourteen years. Case 9 had clinical evidence of brain tumor at about the fifth month of pregnancy. The pregnancy was interrupted by cesarean section in the eighth month because of marked increase of symptoms. The patient died four hours later. Case 10 had a right subtemporal decompression for symptoms and findings suggesting tumor. Thirteen years later after two pregnancies the patient was in good health with no suspicious findings. Case 11 was operated upon at the age of seven by Dr. Harvey Cushing with findings of an old inflammatory process. She was delivered at twenty-four years of age by cesarean section with sterilization by hysterectomy. Case 12, a woman seven months pregnant with history of convulsive seizures and in critical condition on hospital admittance, had exploratory craniotomy. A cyst was evacuated and adhesions freed. Twenty-two days later she delivered spontaneously. She has been followed for five years with medical treatment.

A considerable review of the literature follows. The number of such cases reported has been relatively few. Most authors draw conclusions which seem hardly warranted by the few cases. Confusion of brain tumors with toxemias of pregnancy is most likely in the first trimester. As the authors say "each case must be studied individually." More such excellent reports are needed to form a guide for the handling of such cases.—*E. C. Baker, M.D.*

Tucker, H. St. George, Jr., Chitwood, James L., and Parker, Carl P., Jr. Pituitary myxedema; report of three cases. *Ann. Int. Med.*, Jan., 1950, *32*, 52–62.

The authors present 3 patients with anterior pituitary failure masquerading as myxedema. These patients all presented histories and findings fairly typical of myxedema. Subsequent studies showed each to be an instance of primary pituitary failure with secondary hypothyroidism, together with secondary hypogonadism and deficiency of the adrenal cortex.

In the histories obtained the outstanding feature distinguishing these cases from ordinary myxedema is the loss of genital function, which may be decreased in primary myxedema, but is seldom totally lost. All 3 had loss of libido, impotence and almost complete loss of pubic and axillary hair. The symptoms of adrenal cortical deficiency are more difficult to recognize and may be entirely latent. Ex-

treme weakness and inability to work was a major complaint of these patients. One patient had several spontaneous addisonian crises. None showed any pigmentation of the type seen in Addison's disease.

Physical examination showed the facies and other physical findings of myxedema, plus extremely scanty beard, axillary, pubic and body hair.

Laboratory findings in all 3 cases showed anemia, a constant slight lymphocytosis, and a lowered metabolic rate accompanied by an elevated serum cholesterol. Kepler water diuresis test was strongly positive in all 3 patients, and offered presumptive evidence of adrenocortical deficiency.

Roentgenograms in 2 of the patients showed enlargement of the sella turcica with erosion of the dorsum sellae and posterior clinoids. There was suggestive enlargement of the sella in the other case.

The primary lesion in each of these cases was felt to be a chromophobe adenoma of the pituitary. It was considered unwarranted to attempt surgical removal of the tumor for fear of destroying whatever remaining pituitary tissue there might be left. The tumor was irradiated in each case in the hope of slowing its growth. It is impossible to evaluate the effect of irradiation, since hormonal substitution therapy was instituted simultaneously.

Two of the patients responded well to treatment with thyroid, testosterone, desoxycorticosterone and supplementary salt intake. Both have returned to steady work after prolonged periods of disability, and both are living normal married lives. In the third case the course has been less satisfactory. The patient is stronger and has normal sexual function, but still feels under par. His case also was further complicated by a mitral heart lesion. The authors believe that by the judicious combination of thyroid, adrenal cortical and gonadal substitution, patients such as these can be successfully managed. Dosages will vary in different patients, and can be arrived at only by a prolonged period of trial.—*G. J. Culver, M.D.*

Howarth, J. Cornall, and Bunts, Alexander T. Intracranial meningioma following trauma. *Cleveland Clin. Quart.*, Jan., 1950, *17*, 14–18.

Howarth and Bunts report the case of a fifty-nine year old male who had sustained a depressed fracture in the left frontoparietal region, never elevated. Twenty years later he started having jacksonian convulsive seizures, reporting about ten during the following year.

Roentgen films showed evidence of the old depressed fracture. Encephalography showed dilatation of both lateral ventricles and the third ventricle, with slight displacement of the whole ventricular system to the right. The diagnostic impression was depressed fracture as the cause of the jacksonian convulsive seizures.

An operation was performed for the purpose of elevating the depressed calvarial fragment. To the surprise of the surgeon, a tumor was encountered at the exact location of the previous depressed fracture. The encapsulated tumor had the gross appearance of a meningioma. It was easily removed, and microscopic examination revealed a meningioma of meningothelial type.

The findings at craniotomy and the other available facts suggest that the tumor originated as a direct result of the depressed fracture.—*A. A. Brewer, M.D.*

Wise, Robert E., and Geist, Robert M., Jr. Arteriography in cerebral arteriovenous malformation. *Cleveland Clin. Quart.*, Jan., 1950, *17*, 22–25.

The term cerebral arteriovenous aneurysm is used to designate that type of cerebral vascular lesion in which the arterial and venous circulations are connected by a nest or cluster of racemose vessels. Having demonstrated 8 arteriovenous malformations in a series of 150 arteriograms, the authors suggest that this is a more common entity than originally believed.

There is often history of epileptic seizures, migraine type headaches, and permanent or transient paralysis. The neurologic pattern is usually bizarre. Physical findings, electroencephalography, roentgen examination and encephalography may be suggestive but rarely positively diagnostic. However, cerebral arteriography offers a means of positive preoperative diagnosis and enables one to evaluate and localize the lesion accurately.

At the Cleveland Clinic the procedure is done under general anesthesia, routinely using sodium pentothal. Ten cubic centimeters of diodrast is rapidly injected into the carotid artery and a lateral film made; the injection is repeated and a posterioanterior film made.

One case is reported in detail.—*A. A. Brewer, M.D.*

MacDonald, Ian. Combined radical cervicofacial procedures for primary facial cancer. *Surg., Gynec. & Obst.*, Jan., 1950, *90*, 16–20.

There are certain primary cancers of the head and face which, because of their anatomical relation to the lymphatic pathways, usually present a pattern of almost continuous metastatic node involvement from the primary site to the clavicle. The sites in which these neoplasms occur include the lateral areas of the face together with the temporal portions of the scalp, the pre- and postauricular areas as well as the auricle itself. The metastases may develop first in the periauricular nodes, then spread around the parotid gland and then into the adjacent submandibular lymph nodes. From this point those lesions located in or anterior to the auricle metastasize into the anterolateral triangle of the neck while those behind the ear extend into the posterior cervical triangle.

It may be seen that local excision of the primary neoplasm, though performed in radical fashion and followed some time later by block dissection of the neck, may not effect a cure because of the subsequent development of cancer in the undissected area separating the two operative fields.

The malignant neoplasms which spread in this fashion are usually cutaneous in origin and include the squamous cell carcinomas, the melanomas and, occasionally, the malignant variants of the salivary gland tumors. Squamous cell carcinoma is the commonest of these lesions. If there is actual invasion of bone or cartilage or if there is extension to the lymph nodes, irradiation has certain limitations as the treatment of choice. A radiosensitive neoplasm becomes radioresistant in an osseous or cartilaginous bed. If the neoplasm is destroyed in these tissues, the sequela of radiation necrosis, sequestration, and painful osteitis or chondritis are very likely. Squamous carcinoma is also refractory to irradiation in lymph node deposits. Radical surgery would seem to offer the only prospect of cure in these cases.

As in malignant melanoma in other primary sites, a large proportion will have metastasized beyond the local and cervical areas of lymph node drainage before treatment. For the small potentially curable fraction, radical local excision and block dissection in its most drastic form offers the only effective means of cure.

To summarize, certain malignant neoplasms, namely squamous cell carcinoma and melanoma, originating in the auricle or adjacent skin usually disseminate locally by continuous lymphatic spread through the auricular, periparotid and submandibular nodes to the deep cervical nodes. Their cure demands a combined radical cervicofacial procedure with en bloc removal of the primary tumor, the local nodes, and the products of block dissection of the neck.—*Mary Frances Vastine, M.D.*

NECK AND CHEST

Corbett, Austin J., and McClintock, John C. Tumor of the carotid body associated with nodular goiter; report of a case. *Arch. Surg.*, Jan., 1950, *60*, 81–86.

Carotid body tumors are usually lobulated, encapsulated, and average 3 to 4 cm. in diameter. Though usually unilateral, bilateral tumors have been described. They adhere to and often encircle the great vessels.

According to some authors these tumors, with but few exceptions, are benign, slowly growing, and produce no metastases. Usually they appear as painless firm nodules which cause symptoms as the result of pressure upon neighboring structures.

A patient is presented who revealed two masses in the neck, one near the angle of the jaw, the second in the base of the neck, At operation a soft tumor, freely movable was removed which proved to be a carotid body tumor associated with a nodular goiter.—*P. J. Hodes, M.D.*

Esser, Claus. Zur Frage des unterschiedlichen Verhaltens bestimmter Lungenabschnitte. (On the different behavior of different segments of the lungs.) *Klin. Wchnschr.*, Feb. 1, 1950, *28*, 81–88.

Certain diseases of the lungs are confined in their extent within the limits of the distribution of bronchi. The anatomical structure of the bronchi and of the segments of the lung supplied by them is well known. These segments are rather sharply circumscribed and have received a definite anatomical nomenclature even though it is not as yet uniform.

The anatomical and functional segments of the lung are evidently the same, based on the anatomical distribution of the nerves.

Bronchial occlusion, proved anatomicopathologically, bronchoscopically, and roentgenologically, is the mechanical cause for the

segmental distribution of the secondary inflammatory changes.

Not only diseases of the lung parenchyma but also some vascular disturbances lead to segmental involvement, definitely limited to certain portions of the lung. This is not surprising since arteries and bronchi run in pairs down to their terminal ends. A definite segmental distribution of lung edema, for instance, can best be explained by the primary action of the nervous system either on the arteriocapillary or the bronchopulmonary system. A similar localization of parenchymatous and vascular changes seems to indicate the presence of anatomically well defined and functionally uniform segments of the lung which may well be controlled by their supply of nerves. An anatomical basis for this hypothesis has not as yet been proved.—*H. W. Hefke, M.D.*

Jackson, Chevalier. Bronchial obstruction. *Dis. of Chest*, Feb., 1950, *17*, 125–150.

Bronchial obstruction, temporary or prolonged, is a universal pathologic occurrence; it is common among the newborn; it affects everyone many times later in life, and it is commonly the terminal phase in slow deaths from any cause. Only the cough reflex prevents us all from drowning in our own secretions. Only the cough reflex prevents extermination of the human race by bronchial obstruction.

The bronchoscope, twenty-six years ago, revealed the clinical fact that in the living bronchi, normal rhythmic respiratory movements produced valvular types of obstruction that caused emphysema and atelectasis in the respective tributary areas. The mechanism of two of the types was similar to the stop valves and check valves common in mechanical engineering, but the most frequently encountered type of mechanism was unknown to mechanical engineers. This newly discovered mechanism was named the "expansile check-valve." It converts the rhythmic respiratory to-and-fro flow of the gaseous contents of the bronchi into a one-way flow. The inspiratory diametric luminal enlargement opens a chink past an obstruction, but the expiratory diametric luminal diminution closes the chink at the beginning of expiration, trapping the air before it can escape. Though the quantity trapped at each expiration is small, repetition 18 or more times a minute soon results in emphysema of the tributary lung, lobe or segment. This expansile type of one-way valve is irreversible. The two types of one-way valvular mechanism known to mechanical engineers, the ball valve and the flapper valve, are reversible; and when they occur in reversed position in a bronchus, they rapidly cause atelectasis. They are often seen to produce atelectasis in a few minutes, whereas absorption of air by the circulation after a stop-valve obstruction usually takes twenty-four hours or more to cause atelectasis. A flapper valve may cause atelectasis in one lobe and at the same time an emphysema in another lobe.

Various causes of bronchial obstruction are discussed. The most frequent are pathologic secretions and exudates that the cough reflex cannot expel because of their greatly increased adhesiveness and cohesiveness. Difficulty of expulsion is also greatly increased by accumulation. Opiates are the most frequently prescribed frustraters of the vital defense of the lungs. Their routine use as antitussives is one of the most deplorable and widely spread therapeutic errors in the history of medicine. Prompt arrest of beginning stagnation of pathologic secretions and exudates, when subacute bronchitis lingers after acute infections of the respiratory tract, will prevent chronic bronchitis and bronchiectasis which are so often the sequelae of such acute infections.—*E. J. McDonald, M.D.*

Laivaag, Kaare. Bronchiogenic carcinoma. *Acta chir. Scandinav.*, 1949, *98*, 182–204.

This is a careful and detailed analysis of 80 cases of bronchiogenic carcinoma, carrying over the twelve year period of 1936 to 1948. The findings, for the most part, do not differ from those of other investigators, who have analyzed comparable large groups. This abstract takes up the roentgenographic findings, and those seeking further details should refer to the original article.

The segmental distribution of these tumors was as follows: 36 were found in the upper lobes, 24 in the lower lobes, and 4 in the right middle lobe. In 15 cases the tumor site was not definitely determined by the author. The majority of the carcinomas were found to occupy a central position in the lung field, arising from the larger bronchi. Eleven of the 80 tumors were classified as peripheral, and in all instances were sharply circumscribed. Atelectasis was present in 70 per cent of the

cases reviewed, being lobar in type in 37 of the cases, segmental in 13 cases, and total in 5 cases. In 5 cases necrosis of sufficient extent had occurred in the atelectatic area, so that the tumor was presenting primarily as a lung abscess. Minor abscesses, however, were indubitably a more common complication. In 2 cases there was elevation of the diaphragm, owing to infiltration of the phrenic nerve, and pleural effusion was present in 14 cases. To evaluate those cases situated in the central and intermediate portions of the lung fields, planigraphy was performed in 35 instances, and bronchography in 22 instances. In 33 of the 35 cases planigrams showed definite bronchostenosis. Bronchography in all 22 cases showed a similar finding. In 32 of 47 cases examined by either bronchography or planigraphy, biopsy material was obtainable by bronchoscopy. In the remaining 15 cases the area of stenosis was inaccessible to the bronchoscope. Most of the inaccessible tumors occurred. in the upper lobe. The author is of the opinion that the planigram is superior to the bronchogram in that it reveals more exactly the size of the tumor shadow itself, and obviates the risk of contrast medium being retained in the lung, where it may give rise to atelectasis.—*E. C. Lasser, M.D.*

Woolner, L. B., and McDonald, J. R. Cytologic diagnosis of bronchogenic carcinoma. *Dis. of Chest*, Jan., 1950, *17*, 1–10.

The authors examined sputum and bronchial secretions cytologically from approximately 6,000 patients and demonstrated the presence of carcinoma in more than 400 cases. Sputum studies accounted for four-fifths of the positive cases and bronchial secretions, smears and washings, accounted for the remainder. The authors state that sputum and bronchial secretions are of equal value in detecting carcinoma cells with each method having their advantages and disadvantages. A technique for preparing the sputum for study and the general characteristics of exfoliative carcinoma cells are described. False positive diagnoses were made in approximately 2 per cent and some of these were due to lesions in the upper respiratory tract or esophagus. False negative diagnoses occurred in approximately 30 per cent with the tumor being in the periphery and/or having no communication with the bronchial tree.

In a series of 80 consecutively removed bronchogenic carcinomas over a two year period, 40 were squamous cell carcinomas, 20 were of the large cell type, 15 were adenocarcinomas and 5 were of the oat cell type. Bronchoscopy and biopsy gave positive results in 47.5 per cent and sputum and bronchial secretions gave positive results in 70 per cent. By combining the above procedures a preoperative diagnosis of carcinoma was made in 73.8 per cent. Squamous cell and the small or oat cell carcinoma show more frequent cytologic findings due to involvement of the larger bronchi, whereas the adenocarcinoma tends to be more peripheral and frequently has no bronchial communication. The adenoma and cylindroma give negative results because of an intact mucosa. The alveolar cell tumor may give atypical cells in the sputum and aid in a preoperative diagnosis.—*C. W. Cooley, M.D.*

Rienhoff, W. F., Jr. A clinical analysis and follow-up study of five hundred and two cases of carcinoma of the lung. *Dis. of Chest*, Jan., 1950, *17*, 33–54.

Carcinoma of the lung is discussed generally and the various topics include a clinical analysis, diagnosis, pathology, treatment and an analysis of 502 cases of carcinoma of the lung referred for surgical treatment. The incidence was higher in males in a rate of six to one. The age group affected varied but was most frequent in the fourth to sixth decades. The signs and symptoms of carcinoma of the lung most commonly found were: cough 71 per cent, hemoptysis 63 per cent, pain 50 per cent, loss of weight 39 per cent, hyperpnea 23 per cent, pneumonitis 18 per cent, fever 13 per cent and tightness in chest 3 per cent. Roentgenography of the chest is the most important method of detection. Bronchogenic carcinoma may be evidenced by a mass or produce atelectasis, bronchiectasis, pneumonitis or abscess due to occluding a bronchus or its branches. Bronchoscopy is next in importance and in 50 per cent of this series a positive biopsy was obtained. Bronchography and transthoracic aspiration biopsy were of some value. Exploratory thoracotomy was used quite often and especially when the diagnosis was uncertain. Squamous cell carcinomas were the most frequent in the series being 50 per cent, flat cell carcinomas 14 per cent, adenocarcinomas 28 per cent and cylindrical and oat cell carcinomas 4 per cent each. Patients with the squamous or flat cell type lived longer than those with the adenocarcinoma type.

The clinical course depends on the method of

growth. The intrabronchial type produces greater respiratory difficulties than the extrabronchial tumors. Early symptoms of the latter may be a Horner's syndrome, recurrent laryngeal palsy or interference with venous return of the neck due to involvement of the superior vena cava. The peripheral tumors are relatively asymptomatic and eventually involve the pleura, chest wall and the brachial plexus. In addition to regional node metastases, metastases occurred most frequently in the supraclavicular and axillary lymph nodes, and then in the liver, pleura, pericardium, heart, contralateral lung, bone, brain, skin and subcutaneous tissue. An analysis of 502 cases showed that 69 per cent were inoperable. Of the 31 per cent that were operable, metastases had occurred to the bronchial and tracheal lymph nodes in 70 per cent; 90 per cent of the malignancies of the lung occurred near the hilus and 10 per cent in the periphery. The group of patients that lived up to six years following operation were benefited in that the coughing, hemoptysis and extensive pulmonary suppuration were relieved. The author has 16 cases that have survived for five years and more, with 5 living over twelve years.—*C. W. Cooley, M.D.*

Meyer, John H. Pulmonary alveolar adenomatosis; report of a case. *Am. Rev. Tuberc.*, Jan., 1950, *61*, 131–137.

A thirty-five year old woman was admitted to the hopital two months after the onset of respiratory symptoms. She died four months later. Both lungs showed disseminated miliary lesions, which coalesced toward the bases. Microscopically the diagnosis was pulmonary alveolar adenomatosis.—*Lois Cowan Collins, M.D.*

Spain, David M., and Thomas, Albert G. The pulmonary manifestations of scleroderma: an anatomic-physiological correlation. *Ann. Int. Med.*, Jan., 1950, *32*, 152–161.

The authors report a case of scleroderma in which the clinical features were almost entirely related to the pulmonary changes. Extensive cardiophysiologic studies were made, and an autopsy was performed which permitted a correlation of anatomic and functional findings.

The most striking changes at autopsy were noted in relation to the impairment of respiratory function rather than to ventilatory disturbances. That is, the marked thickening of alveolar walls by fibrosis and the narrowing of the lumina, thickening of vascular walls and obliteration of many of these vessels in the lungs could adequately explain the interference with the exchange of gas over the alveolar interspace. The latter was illustrated by a low O_2 content of the arterial blood after exercise.

Speculation is made as to the mechanism by which the widespread bronchiolectasis found may have developed.—*G. J. Culver, M.D.*

Edwards, Herbert R., and Drolet, Godias J. The implications of changing morbidity and mortality rates from tuberculosis. *Am. Rev. Tuberc.*, Jan., 1950, *61*, 39–50.

The tuberculosis death rate in the United States has fallen by 20 per cent since 1940, but the number of reported new cases has increased by 33 per cent. In part, the increase in reported cases may be due to increasing efforts to make the diagnosis of the disease, but other factors which must be taken into consideration are wartime migration of workers to industrial centers, overwork, inadequate housing, and influx of Puerto Ricans and displaced persons into the United States. It is impossible to judge which factor plays the larger part in accounting for the increased number of reported cases, but there is no doubt that the estimation of facilities required for the care of tuberculosis patients must be based upon the number of known active cases rather than upon the number of deaths, as it has in the past.—*Lois Cowan Collins, M.D.*

Katz, Julius, and Plunkett, Robert E. Prevalence of clinically significant pulmonary tuberculosis among inmates of New York State penal institutions. *Am. Rev. Tuberc.*, Jan., 1950, *61*, 51–56.

Chest roentgenographic surveys in fifteen penal institutions in New York State revealed clinically significant tuberculosis in 1.2 per cent of males, and 0.7 per cent of females.

Similarly high tuberculosis rates in other penal institutions are quoted from the literature.

Since, in the general population, the tuberculosis rate is estimated at 0.3 per cent, these figures indicate that tuberculosis control programs should be instituted in penal institutions, not merely for the care of the tuberculous inmates, but also for the protection of the nontuberculous inmates and employees.—*Lois Cowan Collins, M.D.*

Levitin, Milton, and Zelman, Morris. Excisional surgical treatment of pulmonary tuberculosis in children. *Am. J. Dis. Child.*, Jan., 1950, *79*, 30–41.

Four cases in which pneumonectomy for pulmonary tuberculosis was performed in children are reported. The children ranged in age from three to thirteen years. Three were well at the time of submission of the paper for publication. They were asymptomatic and their gastric washings repeatedly contained no acid-fast bacilli. Analysis of the case in which failure occurred revealed the following possible causes of failure: (1) An exudative lesion was present in the contralateral lung at the time of surgical treatment. This was recognized then, but, since the patient's prognosis was hopeless and since many exudative lesions heal spontaneously, it was decided to proceed with surgical intervention. (2) The surgical procedure was performed without the protective and beneficial effects of streptomycin. (3) At the time of surgical treatment, the patient was in the adolescent period, at best a dangerous age for the spread of tuberculous lesions. She lived more than two and a half years following the operation and it is questionable whether this survival would have been possible with other therapy.

It is difficult, the authors state, to set down criteria for this operation for patients of the pediatric age group. They think the two most important indications in children are progressive unilateral disease and failure, or expected failure, of collapse therapy to arrest the pathologic invasion. There may be another indication also in children, namely, the progressive primary complex. In this condition there is a rapid progression of the pathologic invasion, usually beginning in one lung and terminating fatally. It is difficult to diagnose since the spread may stop at any time and spontaneous recovery occur.

The ultimate prognosis of these patients, the authors state, must be viewed from two aspects: (1) the status of the tuberculous lesion in the contralateral lung after operation, and (2) the future cardiopulmonary reserve. A factor which may materially alter the prognosis in children is the lymph node component. Except for their first case, streptomycin and penicillin were given routinely before and after operation, and their use materially bettered the operative results.

The policy of not performing thoracoplasty, routinely advised for adults, in children after pneumonectomy may be of value in allowing more space for the remaining lung to become hypertrophied. It is obvious that when lobectomy can be performed instead of total removal of the lung, the prognosis from a functional standpoint would be much better.—*R. S. Bromer, M.D.*

Hartweg, Helmut. Über die Boecksche Krankheit der Lungen; Lymphogranulomatosis benigna pulmonum. (On Boeck's disease of the lungs; lymphogranulomatosis benigna pulmonum.) *Fortschr. a. d. Geb. d. Röntgenstrahlen ver. m. Röntgenpraxis*, Feb., 1950, *72*, 385–408.

Boeck's disease of the lungs is a chronic condition with an average duration of eight to ten years, but has been observed to pass through all stages within six months. Even then no signs of an acute illness occur. Roentgenological findings and a negative tuberculin reaction are usually the only significant signs. It is generally agreed that the disease is infectious and some cases have been known to become tuberculous. The intrathoracic localization of Boeck's disease can occur with or without other manifestations. Involvement of the skin and bones is rarely found in the early stages of the pulmonary disease, while iridocyclitis and swelling of the salivary and lacrimal glands occur more frequently.

Pulmonary involvement in Boeck's disease is usually asymptomatic and uncharacteristic. Only in a few advanced cases was right-sided heart failure observed.

The authors feel that they can distinguish among five different stages of pulmonary involvement.

The first stage shows a characteristic swelling of the hilar nodes.

The second stage is characterized by a miliary pattern of involvement of the lungs which may show, in addition, a fine reticular predominantly perihilar network. This may be due to stasis in the lymph channels or to direct involvement of the lymphatics.

This pattern of involvement disappears during the third stage when a more or less dense pattern of radiation appears which is caused by a progressive fibrosis.

The fourth stage shows a mixture of fibrosis and infiltration and produces a nodular type of involvement.

The authors wonder whether they are justified in adding a fifth stage during which these findings reach an unusual extreme. The infiltration during this period is large and extensive and emphysematous blebs may be present due to the marked fibrosis.

The various stages may occur isolated although often it may be difficult to differentiate between them in an individual case.—*H. P. Mueller, M.D.*

Overholt, R. H., Ramsay, B. H., and Meissner, W. A. Intrathoracic pheochromocytoma; report of a case. *Dis. of Chest*, Jan., 1950, *17*, 55–62.

The occurrence of an intrathoracic tumor arising from the sympathetic nervous system, a pheochromocytoma, is very rare. The authors present a case, the fourth reported in the literature, which showed two unusual features: (1) the absence of hyptertension or of significant symptoms preoperatively, and (2) a violent and dangerous fall in blood pressure during the operation for removal of the tumor.

The case reported was that of a sixteen year old male in whom an asymptomatic tumor of the left side of the thorax was discovered on a routine chest film. The roentgen examination showed an area of increased density, measuring 3.5 cm. in width and 6.5 cm. in length, in the left thoracic gutter at the level of the third, fourth, fifth and sixth dorsal vertebrae.

During the operation, the blood pressure rose to 240/160 mm. Hg. and after removal of the epinephrin-secreting tumor, the blood pressure fell rapidly to 90/70 mm. Hg. The immediate hypotension was controlled by the administration of neosynephrine intravenously. The patient made a complete recovery. The pathologic diagnosis was pheochromocytoma.

Pheochromocytomas are usually associated with persistent or paroxysmal hypertension, headache, palpitation, excessive sweating, heat intolerance, nausea or tachycardia. However, all of these symptoms may be absent when the tumor is situated within the thorax and the presence of an intrathoracic pheochromocytoma may be disclosed only by the discovery of a tumor in the roentgen examination of the chest. The roentgen appearance is not characteristic and the diagnosis can be made only by operative removal and pathologic examination of the tumor.—*G. Lavner, M.D.*

Cassel, M. A., Cunningham, B. T., and Weisel, Wilson. A foregut cyst of the mediastinum. *J. Thoracic Surg.*, Jan., 1950, *19*, 138–143.

Less than 10 cases of cysts containing esophageal, gastric or enteric and respiratory elements have been reported in the literature.

The case of a twenty-four year old white male is reported who was asymptomatic and in whom a posterior mediastinal tumor was discovered by a routine chest roengten examination. The cyst was removed surgically and pathologic examination revealed a living epithelium similar to that found in the respiratory tract, esophagus, stomach and intestines.

The many theories attempting to explain the origin of mediastinal cysts are discussed. The most likely hypothesis postulates their origin from embryonic diverticula of the alimentary system or foregut.

The authors state that if many sections were examined from the so-called bronchial or gastric cysts, or esophageal duplications, the type of epithelium described in their case would be more commonly found.

The symptoms and complications of mediastinal cysts are discussed.—*F. M. Reis, M.D.*

Kunstadter, Ralph H., Milzer, Albert, and Whitcomb, Frances. Bronchopulmonary geotrichosis in children. *Am. J. Dis. Child.*, Jan., 1950, *79*, 82–90.

Two cases of geotrichosis in children are reported giving in detail the clinical course and roentgenographic appearance of the lungs. The children were six and four years of age. A two year old sibling and both parents also reacted positively to the *Geotrichum* skin test but showed no evidence of pulmonary disease. The father gave a positive reaction to histoplasmin and a negative reaction to tuberculin. A roentgenogram of his chest revealed multiple calcified areas in the left lung and hilar region which probably represented the healed histoplasmosis and/or geotrichosis.

In the first patient a diagnosis of pulmonary mycosis was made on the basis of the roentgenographic findings of persistent, soft, mottled-appearing infiltrations throughout both pulmonary fields, associated with hilar adenopathy, a whitish, mucoid and at times a flaky sputum and a negative tuberculin reaction. In the second patient, hilar adenopathy and diffuse, patchy infiltrations extending out from both

hilar areas were shown on roentgenographic examination.

Iodide therapy and roentgen irradiation in the first case resulted in gradual improvement of the older child over a period of nine months. Iodide therapy alone resulted in a more rapid and complete clearing of the pneumonic process in the younger child during seven months of observation.

Geotrichosis must be differentiated from other mycoses, such as moniliasis, North American blastomycosis, cryptococcosis, coccidioidomycosis, and histoplasmosis. An attempt to establish an etiologic diagnosis should be made by the use of all available diagnostic facilities, including history, serial roentgenograms, fungous skin tests, and cultures of sputum and bronchial secretions.—*R. S. Bromer, M.D.*

Torgersen, Johan. The developmental anatomy of the heart and the etiology of congenital heart disease. *Acta radiol.*, Feb., 1950, *33*, 131–146.

In his comments the author includes the following observations:

1. There is a genetic relationship between transposition of the great vessels and visceral inversion.

2. Both malformation of the heart and situs inversus are correlated with a defective development of the lower jaw.

3. Heart defects occur in cases of harelip and cleft palate more frequently than expected if the combination was due to chance.

4. The relationship to the derivatives of the gill arches is obvious in the high correlation between abnormalities of the aortic arches, heart defects and situs inversus.

5. According to Taussig, anomalies of the spine are common in heart defects.

6. Defects of the septa in arachnodactyly and in mongolism show the relationship between abnormal growth of the body and a maldevelopment of the heart.

7. The relatively frequent occurrence of supernumerary nipples in children with congenital heart disease demonstrates the relationship between sexual differentiation and the development of the heart.

8. The fact that transposition and related anomalies are more frequent in boys indicates the influence of the chromosomal balance in sex.

9. The frequency of consanguineous marriages in 97 cases of heart defect is 6 per cent as against 2 per cent in the general population.

Summary. There is a correlation between situs inversus, transposition and other congenital heart defects. The occurrence of situs inversus with or without heart defect in one member of a family, and of transposition or other heart defects in other members may be regarded as conclusive evidence that the genetic factors in visceral asymmetry and in the development of the heart influence each other mutually.—*Mary Frances Vastine, M.D.*

Teilum, Gunnar, and Madsen, Valdemar. Endometriosis ovarii et peritonaei caused by hysterosalpingography. (Contribution to the pathogenesis of endometriosis). *J. Obst. & Gynaec. Brit. Emp.*, Feb., 1950, *57*, 10–16.

All examiners are familiar with the occasional serious injuries and the less serious sequelae which follow the introduction of iodized oils as contrast media. Endometriosis caused by hysterosalpingography has not previously been reported.

The authors present 7 cases in which the presence of ectopic endometrium (endometriosis) has been demonstrated histologically in examinations made after hysterosalpingography with iodized oils. Laparotomy was performed in the patients at varying intervals after one or more salpingographic studies. The histological examination of the specimens demonstrates various morphological phases of development w th transition of the surface epithelium of the ovary into metaplastic columnar epithelium of the endometrial type. The changes displayed a topographically strict localization to the edges of lipoid granulomata resulting, in some cases, in epithelium-lined surface cysts and, in others, in the development of endometriosis.—*W. C. MacCarty, Jr., M.D.*

Lynxwiler, Chester, and Wells, Robert C. Patent ductus arteriosus. *South. M. J.*, Jan. 19, 1950, *43*, 61–67.

The authors report 180 cases operated on for a persistent patency of the ductus arteriosus. In this series there were 5 deaths, a mortality rate of 2.7 per cent. Of the 180 patients 120 were followed for six months or longer. These were divided into the following groups:

A. Patent ductus occurring as a single lesion—101 cases

B. Patent ductus associated with rheumatic heart disease—3 cases

C. Patent ductus associated with subacute bacterial endocarditis—6 cases
D. Patent ductus associated with septal defects—10 cases

In the first group there were the typical findings of variations in size and contour of the heart. Eighty patients showed slight fullness in the region of the pulmonary conus, 11 showed marked fullness and 10 had a normal contour. The authors point out that although slight pulsation in the region of the pulmonary conus and a "hilar dance" were common findings in this group, it must be kept in mind that these findings occur with auricular septal defects as well. They concluded that the diagnosis of a patent ductus arteriosus cannot be made on the basis of fluoroscopic and roentgenographic findings.

In the 101 non-complicated patients, there was no evidence of recurrence of the patent ductus following surgery. The continuous murmur and thrill were no longer present postoperatively. There were 93 patients upon whom there was definite information regarding the presence of systolic murmurs at one, six and twelve months following surgery. These murmurs were at the base of the heart, were systolic in time and thought to be functional. They were considered as such because of their location, the quality and the absence of a thrill and the absence of transmission to the back. There was a decrease in the cardiothoracic ratio and the pulse pressure following surgery.

Of the 6 patients who had a complicating subacute bacterial endocarditis, 5 derived definite benefit from the surgical closure of the ductus. One required a second operation. In 1 patient, neither the subacute bacterial endocarditis nor the murmur was affected by closure Before surgery, this patient did not have a continuous murmur, only a harsh systolic murmur and a thrill over the base. At operation a small ductus was found and ligated but the thrill was not obliterated by this procedure. The patient died three weeks later. At autopsy there was found a high ventricular septal defect. The 5 remaining patients with the complicating subacute bacterial endocarditis were cured.

The authors state that in the preoperative evaluation, if the murmur is not typical, one should be cautious in making the diagnosis of patent ductus. Also murmurs in addition to the typical continuous murmur of the ductus should arouse suspicion of a septal defect complicating the patent ductus.

In general, the 7 patients who had auricular septal defects associated with the patent ductus derived the same benefits from the surgical closure as the patient in whom the patent ductus occurred as an isolated lesion. Although closure of the ductus does not restore the heart to normal, it at least removes one of the causes of cardiac strain and the danger of developing subacute bacterial endocarditis should be considerably less.

The presence of inactive rheumatic heart disease, subacute bacterial endocarditis and auricular or ventricular septal defects is not a contraindication to surgical closure of a patent ductus arteriosus.

The indications for arterial oxygen saturation studies and the cardiac catheterizations are discussed.—*J. G. Snead, M.D.*

Nohrman, Bengt A. Spontaneous regression of pleural carcinosis in breast cancer; report of a case. *Acta radiol.*, Jan., 1950, *33*, 12–15.

In a series of breast cancer cases studied by the author there were included 767 radical mastectomies. Of these 4.6 per cent developed metastases to the pleura within five years following operation. Another 4.5 per cent developed pleural metastases in the following five year period. Pleural metastases were localized to the operated side of the thorax in 65 per cent of the cases and to the opposite side in 20 per cent. They were bilateral in 15 per cent. The diagnosis was made by finding a rapidly increasing exudate containing tumor cells.

There were 35 cases of pleural metastases in all and, of these, 6, or 17.1 per cent, were alive one year after the diagnosis was established. After two years, only 1 patient survived and she did not die until the fifth year following the discovery of the pleural involvement. This case has been reported in some detail. It is postulated that the primary tumor in this patient arose in the medial half of the left breast with metastatic spread to the parasternal nodes. Later on, there was a secondary spreading to the right pleura where the metastases underwent spontaneous regression. The patient was free from symptoms for more than three years. Then another dissemination of the metastases took place and death ensued.—*Mary Frances Vastine, M.D.*

de Carvalho, Lopo. Angiocardiopneumography. *Dis. of Chest*, March, 1950, *17*, 312–336.

Lopo de Carvalho performed the first angiographic examination of the heart in February, 1931. This article represents an excellent summary of his past work and describes his new contributions. He began this work by auricular catheterization and injecting 30 per cent and more concentrated solutions of sodium iodide into the auricle. While adequate contrast was obtained with this solution, it was extremely painful.

The development and use of the present iodine solutions did away with the pain and they could then be injected directly into an arm vein. This simplified the technique of angiocardiography, but according to de Carvalho, the films were not as clear and "contrasty" as those obtained by injecting opaque material directly into the auricle for two reasons: (1) the concentration of the opaque chemical was reduced as it mixed with the large quantities of blood coming from the two venae cavae, and (2) the venous flow in the arm is slow and part of the chemical is temporarily retained along the walls of the veins.

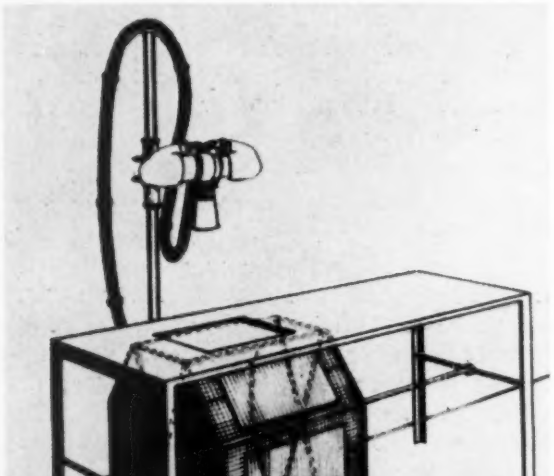

Fig. 1. Plan of the rotary prismatic selector with automatic discharge of the roentgen tube. (Reproduced by permission from *Dis. of Chest*, March, 1950, *17*, 312–336.)

To overcome the inconvenience of auricular catheterization and yet to obtain the quickest maximum filling of the auricle, de Carvalho now recommends the injection of 20 to 30 cc. of the opaque chemical into the external jugular vein. He points out that the negative venous pressure in the vena cava produces a more rapid flow of the opaque material from the jugular vein into the auricle.

At present the author is using "opaxil" produced by Schering and is probably what we are accustomed to calling "neo-iopax" which he states, "does not promote the slightest reaction."

de Carvalho has been accustomed to taking one, two or three successive roentgenograms for years. Since January, 1949 however, he has been using his manually operated rotary prismatic selector which consists of an eight-sided barrel placed under the table to which are fixed eight cassettes (Fig. 1). At the beginning of the injection of the contrast medium, the prismatic selector is rotated and as each cassette comes into position at the top of the table, a roentgen exposure is automatically made. The speed at which successive roentgenograms can be made is not indicated.

The author was one of the first to demonstrate that the majority of the hilar shadows were due to the pulmonary arteries and not to tracheobronchial adenopathy. He has presented a series of films showing how various diseases may alter the blood supply to the lung. For example, he believes that tuberculous foci are bereft of any depreciable circulation while there is an increased blood supply in the region of lung abscesses. He believes this observation can be used to distinguish between these two disorders. He also points out that there is a great decrease in the pulmonary circulation of the lung collapsed by pneumothorax. From this he deducts that the suppression of the blood supply induced by pneumothorax does not allow the toxins produced in the region of the tuberculous foci to continue to be absorbed and disseminated throughout the organism.

de Carvalho has outlined an angiocardiographic technique for determining the exact circulation time in the lungs. Most of the methods in use today depend on the cooperation of the patient and are not objective. To overcome this, the author has made "quimograph" records of the pulmonary circulation (Fig. 2). The technique consists essentially of a roentgen

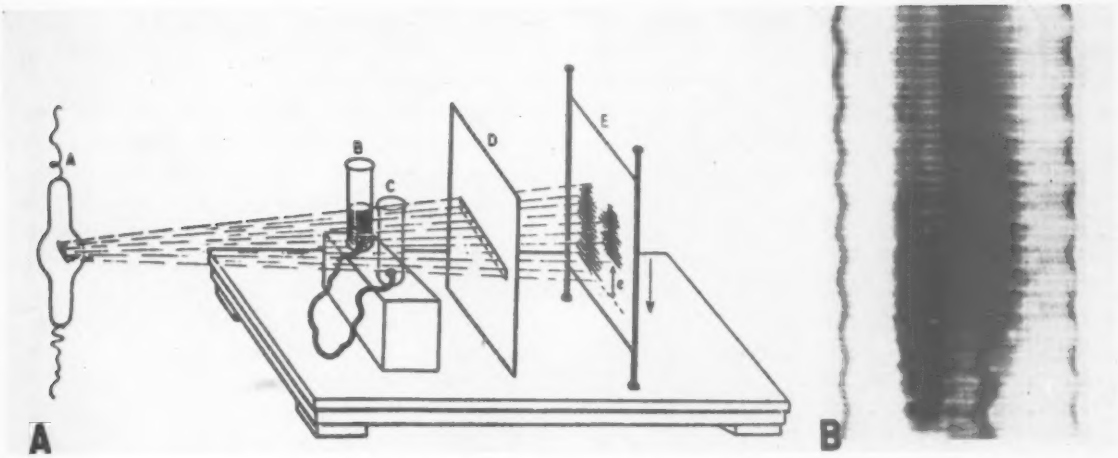

Fig. 2. (*A*) Diagram illustrating principle of the "quimograph": A, roentgen tube; B and C, communicating vessels; D, lead plate with transverse slit; E, carriage with downward movement. The entry of the opaque medium from vessel B into vessel C is recorded kymographically. The distance between the beginning of the two kymographic bands, E, represents the time interval of the circulation through the small tube connecting the two vessels. (*B*) Kymographic record of the pulmonary circulation in the rabbit. (Reproduced by permission from *Dis. of Chest*, March, 1950, *17*, 312–336.)

kymographic recording of the entry of an opaque medium into the right auricle and its subsequent appearance in the left auricle. This he accomplishes by placing a solid lead sheet with a single narrow horizontal slit in it in front of the film. The slit in the lead sheet is placed horizontally across the two auricles. The patient faces the lead sheet and is in contact with it. During the roentgen exposure the film is moved slowly down behind the lead sheet at a constant rate of speed. Thus, knowing the speed at which the cassette moves, it is easy to calculate the time that it takes from the appearance of the contrast medium entering the right auricle until it arrives in the left auricle. The roentgenographic appearance of the contrast medium arriving at the right auricle is recognized as a more or less uniform kymographic band which de Carvalho and his associates, de Sousa and Vidal, have termed the right auriculoventricular band. A few seconds later this band suddenly widens, due to the arrival of the opaque material in the left auricle, and a second band is formed beside the first, which they term the left auriculoventricular band. The distance on the film from the beginning of the right auriculoventricular band to the beginning of the left auriculoventricular band represents the time interval of the pulmonary circulation.

Using this same method they have also determined the time which it takes for the blood stream to pass through the cardiac cavities and the circulation time in any lobe of the lung. These determinations are made by placing the kymographic slit not over the heart, but a little higher, at the level of the great vessels. In this position, it is placed across the superior vena cava, the aorta and the two apical arterial and corresponding venous branches of the superior lobes of the lung. Following the injection of the opaque medium, the film is put in motion and the various bands for each of these structures is recorded with the appearance of the chemical in each. Knowing the speed at which the film descends and the distance between the appearance of the chemical in each branch, the circulation time can then be easily calculated. The interpretation of these bands requires some experience and study for they are rather intricate.

By using the "quimograph," de Carvalho has been able to study the pulmonary circulation in the different lobes by placing the single slit in the kymograph vertically from the top to the bottom of the lung. Analyses of these tracings indicate that the pulmonary circulation is rich and abundant in the middle and lower lobes of the lungs, but is quite sparse in the upper lobes. He believes that the spout circulation in the upper lobes is probably the cause of the apical localization of tuberculous lesions.

All in all, de Carvalho has developed an ingenious method and apparently a practical one for the objective determination of circulatory

time by the use of his "quimograph" technique. His article is profusely illustrated with 28 figures and is recommended as an excellent study for all who are interested in angiocardiography and cardiology as well as in the physiology of the lung.—*W. G. Scott, M.D.*

Steinberg, Israel, Dotter, Charles T., and Andrus, William DeW. Angiogardiography in thoracic surgery. *Surg., Gynec. & Obst.*, Jan., 1950, *90*, 45–59.

Angiocardiography was introduced by Robb and Steinberg in 1938. The procedure consists of roentgenographic visualization of the chest at intervals following the rapid intravenous injection of a radiopaque substance. By this method the innominate veins, the superior vena cava, the right atrium and ventricle, the pulmonary artery and its branches, the pulmonary veins, the left atrium and ventricle and the thoracic aorta and its brachiocephalic branches may be rendered sufficiently opaque to distinguish them from the surrounding structures.

It is the purpose of this presentation to show the value of the method in the diagnosis and treatment of non-vascular lesions of the mediastinum and lung which may be amenable to surgical treatment: (1) By means of angiocardiography such tumors may not only be outlined but their relations to adjacent cardiovascular structures clearly defined. It is safe to say that the most decisive single factor in the successful extirpation of a tumor in this location is its separation from large vessels or parts of the heart with which it may be in intimate contact. (2) Visualization of the pulmonary artery and vein indicates the normal relations of these vessels and the presence of anomalies. It also shows how a pulmonary or mediastinal lesion may obliterate or distort the major pulmonary vessels at the hilus. These findings help the surgeon to decide upon the operability of a given mass and to plan his surgical attack upon it.

The authors' experience with angiocardiography in thoracic surgery has included aneurysms, dermoid, pericardial and bronchogenic cysts, thymic tumors, the lymphomas, bronchogenic carcinoma and chronic pulmonary inflammations including tuberculosis and bronchiectasis. A case report together with excellent illustrations of the angiocardiograms demonstrating each of these lesions is included in the article.—*Mary Frances Vastine, M.D.*

Gordon, A. J., Brahms, S. A., and Sussman, M. L. Visualization of the coronary circulation during angiocardiography. *Am. Heart J.*, Jan., 1950, *39*, 114–124.

One or more coronary arteries have been visualized in at least 10 of approximately 1,200 angiocardiographic examinations performed by the authors in the past eight years. The angiocardiograms were obtained in the usual manner with exposures of about two per second, using 70 per cent diodrast as contrast medium. The R wave in lead CF_3 or CF_4 of the electrocardiogram was amplified to activate a synchronizer so that each exposure was predetermined.

Visualization of the coronary arteries occurred chiefly in children. The aorta and its branches are particularly well visualized in children as compared with adults. The fact that the coronary arteries are not more frequently seen is difficult to explain. In many films the coronary vessels may be filled but are obscured by dye in the pulmonary vessels.

The right main coronary artery was identified several times, the left only once. The usual position of the patient in the left anterior oblique or anteroposterior favors demonstration of the right coronary artery. The left auricle and ventricle are filled with dye at the same time as the aorta and thus the dye-filled left coronary vessels are superimposed on the opaque auricle and ventricle. In order for the left coronary artery to be clearly seen, it would be necessary for the aorta to fill independently of the left auricle and ventricle—this situation pertains in some congenital heart anomalies, notably the tetralogy of Fallot.

The right main coronary arises from the upper part of the bulge at the base of the aorta (sinus of Valsalva), and it courses downward to the right, curving backward and reversing its direction as its caliber decreases. The identity of the left coronary artery is more difficult to establish, but it arises in a similar manner and courses in its expected direction.

The cases presented are those of children ranging in age from two to eight years; 2 with a normal cardiovascular system, 2 exhibiting a patent ductus arteriosus, and 1 suffering from the tetralogy of Fallot. The coronary arteries filled in different phases of the cardiac cycle from early systole to early diastole.

Also presented are 2 cases in which the coronary sinus was visualized in adults during angiocardiography. The dye entered the sinus a few seconds after peripheral injection; it is pre-

sumed that the medium entered refluxly from the right auricle. In the angiocardiogram the coronary sinus is a straight wide branchless vessel arising from the lower border of the right auricle and tapering slightly as it courses upward and backward for 4 to 5 cm.

Roentgenograms illustrate the vessels described.—*Harold Fulton, M.D.*

Green, H., and Apley, J. Study of cardiac enlargement in infancy with case reports of reversible enlargement. *Pediatrics*, Feb., 1950, *5*, 249–256.

It has been generally accepted that marked cardiac enlargement in infancy in the absence of congenital malformations is not compatible with long life. The authors present case histories to show that marked cardiac enlargement in infants can be reversible and life expectancy can be unaffected. Chest roentgenograms were made of 1,000 infants in order to determine the incidence of cardiac enlargement. A transverse cardiac measurement exceeding 5.5 cm. on a film exposed at 6 feet is usually abnormal in the first few days of life. In the authors' series the films were exposed at 7 feet. Sixteen of the 1,000 cases were found to have gross cardiac enlargement. Seven of this group died in the neonatal period; 2 of these had postmortem examinations and were found to have auricular septal defect and von Gierke's disease. Five of the survivors had congenital heart lesions, 2 were not adequately followed and the remaining 2 showed recession of the cardiac enlargement to normal with no sign of residual organic disease.

In order to determine the etiology of all types of cardiac enlargement the records of 200 consecutive autopsies of infants born alive but dying in the neonatal period were examined. Only cases in which the heart weight exceeded 25 grams were considered as enlarged for the purposes of this study. Twenty-nine of the 200 cases studied came within this category. Ten of this group had pathological lung changes including intrauterine aspiration, intrauterine infection, atelectasis, and bronchopneumonia. Eight cases had cardiac malformations. Six cases had erythroblastosis fetalis. The causes of death were listed as miscellaneous in the remaining 5 cases.

This study shows a significant number of cases of cardiac enlargement in which cardiac anomalies were absent. The authors feel that many cases of cardiac enlargement may be due to undiscovered pathological lung changes, may persist for some time, and may show complete recovery with recession of the cardiac enlargement.—*R. M. Harvey, M.D.*

Stauffer, H. M., and Rigler, L. G. Dilatation and pulsation of the left subclavian artery in the roentgen-ray diagnosis of coarctation of the aorta; roentgenkymographic studies in thirteen cases. *Circulation*, Feb., 1950, *1*, 294–298.

In a study of 20 patients with coarctation of the aorta widening of the left upper mediastinal shadow was apparent in the posteroanterior view of the chests of 17 of the patients. This is attributed to dilatation of the left subclavian artery. Pulsations were evident fluoroscopically and with roentgen kymograms.

Rib notching, generally accepted as a pathognomonic sign was not present in 3 of the cases. Rib notching may occur late and occasionally not at all in coarctation of the aorta.

The widening of the left upper mediastinal shadow by the enlarged left subclavian artery contributes to the characteristic decreased roentgen-ray visibility of the aortic knob in this condition.—*F. B. Markunas, M.D.*

Douzelot E., Eman-zade, Am., Heim de Balsac. R., and Metianu, C. Quelques considérations sur la lévocardie et présentation de 2 cas personnels. (Some considerations on levocardia and presentation of two cases.) *Acta med. Scandinav.*, 1949, *136*, 13–25.

Levocardia with complete situs inversus is rare and there is little literature on the subject. Transposition of all the organs in situs inversus is produced in the first stages of embryonic life. In levocardia the development of the heart in the left-sided position occurs a little later, but always before the sixth week, the form with inversion of the cavities being more precocious than that without inversion.

Anatomically levocardia in conjunction with situs inversus may be present with or without inversion of the cavities. In each of these categories there is an ideal form, strictly symmetrical or purely mirror image, and a modified form (not strictly symmetrical). All these forms may be complicated or non-complicated. This classification is theoretical; only the modified and complicated forms have been published to date.

Besides routine history, physical examination electrocardiography and roentgenography, angiocardiography is of considerable aid in study-

ing the cardiac chambers. In one case infundibular stenosis, interventricular septal defect and a dextroposed over-riding aorta were demonstrated. In the second case a high ventricular septal defect with simultaneous filling of the aorta and pulmonary artery was seen. A slight pulmonary stenosis may have been present.

Cyanosis, dyspnea, shortened ether circulation time and right axis deviation were present in both cases.—*Charles Nice, M.D.*

Chi, Paul S. H., and Adams, W. E. Benign tumors of the esophagus. *Arch. Surg.*, Jan., 1950, *60*, 92–101.

The authors add to the literature a report of the successful surgical removal of a large esophageal leiomyoma in the superior mediastinum. A comprehensive review of previously reported benign esophageal tumors is presented, emphasizing their rare incidence and unreliable symptomatology and analyzing the surgical procedures employed by the various authors.—*George Cooper, Jr., M.D.*

Coodley, Eugene L. Pulmonary abscess as complication of hiatal hernia. *Dis. of Chest*, Jan., 1950, *17*, 102–113.

A case is presented of pulmonary abscess associated with diaphragmatic hernia in a fifty-seven year old white male with a history of recurrent right upper quadrant pain. The pain usually occurred at night and often awakened him from sleep and was accompanied by choking and marked dyspnea. Two weeks after such an episode, the patient developed a silent lung abscess in the left lower lobe associated with low grade fever, weight loss, anorexia and weakness. The abscess presumably resulted from aspiration of vomitus with atelectasis and secondary infection. A second episode apparently caused rupture of the abscess with bronchogenic dissemination of the infection to the right lower lobe. The treatment by large doses of sulfonamides and penicillin given intramuscularly and by the aerosol and intratracheal routes resulted in eventual recovery over a period of several months. Gastrointestinal series revealed a large hiatal hernia.

The author discusses the classification, etiology, location, and roentgen appearance and complications of lung abscesses. He reviews the recent literature on therapy including medical treatment by nutritious diet, transfusions, postural drainage, bronchoscopy, and drug therapy with arsenicals, sulfonamides, and penicillin used intramuscularly, by the aerosol method and by intrabronchial instillation. Surgical methods include external drainage and pulmonary rescetion.

The author concludes that medical forms of therapy are indicated in the early stages and the need and time for surgical intervention should depend on response of the patient to medical management. An acute abscess not responding in the first two or three weeks or not cleared by the sixth week should be treated surgically. Surgical management is definitely indicated for abscesses with secondary complications or in abscesses where drainage is inadequate.—*L. K. Sycamore, M.D.*

Simonetti, Marrigo. Considerazioni sugli aspetti radiologici di alcuni casi di pneumotorace extrapleurico. (A discussion of the roentgen aspects of some cases of extrapleural pneumothorax.) *Arch. radiol.*, Dec., 1949, *25*, 42–45.

The author briefly mentions the value of extrapleural pneumothorax when intrapleural pneumothorax cannot be done because of pleural adhesions. The procedure basically, consists in the creation of a space between the parietal pleura and the thoracic wall into which air is introduced and maintained. The approach is usually posterior, or anteriorly above or below the clavicle. The technique is not discussed but involves resection of a posterior rib segment.

The following conclusions were made from a large series of cases so treated:

1. In all cases collapse of the cavity-bearing area was obtained.
2. In a few cases collapse of the cavity was not complete.
3. Fluid in varying amounts developed in the base of the extrapleural sac, but was invariably absorbed with no loss of the pneumothorax.
4. In some cases where intrapleural pneumothorax was ineffective, extrapleural pneumothorax achieved a good apicolysis.
5. Partial encapsulations of the extrapleural air were observed when the parietal pleura was not fully detached from the thoracic wall.

Twenty representative cases with roentgenograms are presented to demonstrate the effectiveness of the procedure.—*C. Colangelo, M.D.*

Meyler, L., and Huizinga, E. Temporary high position of the diaphragm. *J. Thoracic Surg.*, Feb., 1950, *19*, 283–289.

The paralysis of the diaphragm caused by a lesion of the phrenic nerve is usually due to a

surgical operation. Neurotrophic toxins, especially in diphtheria, may also affect the phrenic nerve. Mechanical causes are well known: (1) the diaphragm is pushed upward by a subphrenic abscess or by a large liver (tumor, echinococcus cyst, and the like); (2) the diaphragm is pulled upward by a process of shrinkage in the lung or by atelectasis of the lower lobe, due to bronchostenosis.

A dozen patients with high position of the diaphragm due to different causes, were observed. It always concerned the right half of the diaphragm; only once was the left half simultaneously affected. The series consists of two groups: (a) patients who had undergone extirpation of the gallbladder and developed high position of the diaphragm a few days later; (b) patients in whom the high position came about after a pulmonary process or pleurisy, situated near the diaphragm. The authors were able to demonstrate the compression of the basal parts of the lung by the high diaphragm. The pressure of the diaphragm had no effect on the upper lobe.

These patients suffered from a temporary paresis of the diaphragm. The cause of the paresis is not known. It is plausible to consider an inflammatory process of the diaphragm; a diaphragmatitis.

The diaphragm contains many blood and lymph vessels. An inflammatory process in the lower lobe may also attack the diaphragmatic pleura, and consequently the inflammation reaches the diaphragm itself. A similar explanation may be accepted for cases involving operations on the gallbladder—an inflammation of the bed of the gallbladder reaching to the diaphragm. Owing to the operative trauma or the inflammation, fibers of the phrenic nerve may be damaged. Proof for this pathogenesis is not given; it is a theory.

From these described cases it appears that a lesion of the diaphragm has chiefly a local effect: the upper and middle lobes remain in their places, whereas the main lower part of the lower lobe and sometimes also the lower part of the middle lobe are compressed. It is clear that the reduction of the lung is achieved almost completely at the expense of the parts of the lung situated near the diaphragm.

A similar restricted influence is found on the lung in space-filling processes in the thorax, such as large tumors, pleural exudate, and thickening. The bronchograms are almost uniformly the same, showing a compression only of the neighboring parts of the lung.

The bronchi in the compressed parts of the lung reveal a typical picture. Only the larger ramifications are filled with lipiodol. This, the authors designate as "naked filling." The bronchi are pushed together and have a curled-up appearance. This resembles bronchiectasis, but after expansion of the lung, the bronchogram is perfectly normal.

Excellent roentgenographic reproductions are presented to illustrate the authors' assumptions —*S. N. Tager, M.D.*

ABDOMEN

Ask-Upmark, Erik, and Frantzell, Arne. On the pathophysiology of a peculiar syndrome of acute abdominal distension. *Acta radiol.*, Feb., 1950, *33*, 104–114.

This paper is concerned with the syndrome of acute abdominal distention. The following mechanisms must be considered when this syndrome is present.

1. Acute dilatation of the stomach.
2. Aerophagy.
3. Increased amount of air in the intestine as, for example, in a volvulus.
4. Polycystic kidneys.
5. Pancreatic cyst.
6. Increase in the size of the liver (as in cardiac insufficiency or the precomatous stage of diabetes).
7. Descent in the position of the diaphragm apparently brought about as a reflex elicited by the entrance of food into the stomach.

In the case discussed the last mechanism, as proved by roentgen examinations, was found to be responsible for the distention syndrome. As well as appearing in connection with meals the acute abdominal distention could also be elicited by digital pressure towards the abdominal wall in the midline in the cranial part of the epigastrium. The diaphragmatic descent apparently caused increase in the pressure in the abdominal cavity so that the circumference at the waist was augmented.—*Mary Frances Vastine, M.D.*

Gianturco, C. Fast radiological visceral survey. *Radiology*, Jan., 1950, *54*, 59–63.

The roentgenological visceral survey usually includes the chest, esophagus, stomach, duodenum, upper small bowel, terminal ileum, colon and gallbladder. Occasionally the kidneys are also explored with plain films or with intravenous urograms. To lower the unit cost of each examination and to save valuable time for the

patient a method of more rapid handling of the patients is suggested.

The author's technique is as follows: The patient is requested to take gallbladder dye at 3:00 P.M., no dinner, 2 ounces of castor oil at 8:00 P.M. and report on the following morning without breakfast.

The examination of the gallbladder is done in the roentgenographic room. This organ is examined with the patient prone, in a supine oblique position, and upright. The emptying of the gallbladder is not followed on the assumption that a full gallbladder must have been emptied first.

A kidney, ureter, bladder study, an intravenous urogram (stereo films) or a chest examination may be done next, along with examination of the spine, skull, sinuses and whatever roentgenographic examination may have been requested in the particular case. The patient is then transferred to the fluoroscopic room where the colon is examined first, with an attempt to fill the terminal ileum. The overexposure technique for colon films is used routinely. This allows detection of polyps without the lengthy and cumbersome air-contrast technique. The patient is then placed in one of three toilets, where he empties the bowel and is given a glass of barium with instructions to drink all but one swallow. Another patient is brought in, his colon is examined, and he is placed in his toilet with the same instructions. A third patient follows. After the examination of the colon of the third patient the first patient is brought back. At this time, the cap, the whole duodenal loop and the upper small bowel are usually well visualized. After examination of the stomach and duodenum, the patient is asked to take the swallow of barium which he had left in the glass and the examination of the esophagus completes the procedure.

For the average patient the time consumed is said to be about forty-five minutes.—*J. J. McCort, M.D.*

Cesarani, Fausto. Considerazioni sul reporto radiologico in tumori ulcerati dello stomaco. (Considerations on the roentgen findings in ulcerated neoplasms of the stomach.) *Radiol. med.*, Feb., 1950, *36*, 97–112.

The author limits his discussion to ulcerative lesions of the lesser curvature in the angular portion of the stomach. After a review of the classical criteria in the determination of benign and malignant ulcers, he concludes that in early lesions the accurate differentiation roentgenologically, clinically and pathologically is not always possible.

It has been stated by numerous authors that a periodic study of a suspected malignant lesion during proper medical therapy will result in a determination of the character of the lesion if there is a reduction in the size of the ulcer and if there is evidence of clinical improvement. The author states that the diminution in the size of the ulcer crater under treatment cannot be accepted as a certain indication that the lesion is benign.

In cases studied by him, roentgen examination conducted after a period of about one month showed definite reduction in the size of the ulcer crater, and apparent clinical improvement. Subsequently, however, roentgenologically the character of the lesion was recognized definitely as neoplastic and the initial favorable clinical response was lost.

It is therefore not advisable to decide on the malignancy of a lesion because of its early favorable response to ulcer therapy. The dependable sign is complete healing of the ulcer.—*A. A. Blasi, M.D.*

Clay, Richard C. Evaluation of gastrostomy for malignant disease. *Arch. Surg.*, Jan., 1950, *60*, 75–80.

The author believes there is little to support gastrostomy as a routine prodecure in patients with dysphagia due to malignant disease. In his experience it has only served to prolong life a few months in persons whose lives were not worth living. He advises careful evaluation of each case remembering always that resection of the involved area is the treatment of choice. —*P. J. Hodes, M.D.*

Shanks, S. Cochrane. Problems in the x-ray diagnosis of cancer of the stomach. *Proc. Roy. Soc. Med.*, Feb., 1950, *43*, 117–128.

The author states that, on the average, a period of six months elapses between the patient's first visit to the doctor, and the roentgen examination. Usually, therefore, the lesion is in an advanced stage. Early cases should constantly be searched for, and certain features may give rise to difficulty in diagnosis. They are: (1) a very small lesion, (2) an unusual type of lesion such as a plaque, (3) a site that is difficult to examine completely, (4) pre-existing deformity (hiatus hernia or cascade stom-

ach), (5) lesions of the pyloric region, (6) the ulcer-cancer problem.

The importance of using a small amount of barium is mentioned; the better the mucosal visualization, the better the chance of early detection of the small lesion. Berg's aphorism, "The less you give, the more you see" is mentioned. The unusual lesion is one closely simulating a localized gastritis, differentiation often being impossible. In the absence of ulcer, gastritis should be reluctantly considered and gastroscopy requested, as well as repeated critical examinations.

The cardia and fundus constitute the difficult sites. The classical later signs are often absent, and differentiation between an early growth, gastritis, and an anatomic variation may be extremely difficult. Indentation of an enlarged spleen and a fibrinous deposit in the left cupola following ulcer perforation are rare causes of confusing defects. The cascade stomach, sometimes amounting to a transverse volvulus, may completely hide a lesion of the cardia. The pyloric antrum may become aperistaltic and contracted after posterior gastrojejunostomy. Pyloric lesions are notoriously difficult to disentangle. Gastroscopy may be helpful in distinguishing between pylorospasm due to gastritis or benign ulcer and that of carcinoma. Illustrations show practically identical appearing ulcers, near the pylorus, both on the greater curvature side; one proved malignant, the other benign. In regard to the ulcer-cancer problem the author's conclusion is that malignant degeneration occurs but very rarely (6 per cent). The meniscus sign of Kirklin is not considered an invariable differentiating feature of malignant ulcer, the point being well presented by two pertinent illustrations. A malignant ulcer may decrease in size under a rigid therapeutic regimen. The final illustration is that of a case considered a large posterior wall ulcer almost certainly malignant. Surgical exploration revealed a perfectly normal stomach. What caused the pouching of the stomach remains a complete mystery.

The author pleads for gastroscopic study in doubtful cases, and states that the final decision often rests with the clinician. The seventeen illustrations accompanying this article are excellent.—*C. N. Borman, M.D.*

Palmer, Eddy D. Tuberculosis of the stomach and the stomach in tuberculosis; a review with particular reference to gross pathology and gastroscopic diagnosis. *Am. Rev. Tuberc.*, Jan., 1950, *61*, 116–130.

Tuberculosis of the stomach is rare, and manifested in many forms. After consideration of the gross manifestations of the lesions, as described in published reports of gastroscopic, surgical and autopsy material, the author feels that the diagnosis may be correctly made at times on the basis of gastroscopic and roentgenographic findings.

The lesions are classified grossly as ulcerous, infiltrative, tumorous and inflammatory. The author lists four peculiarities of tuberculous gastric lesions which he feels are seldom found in carcinoma and other malignancies:

1. The gastroscopist can recognize undermining of the edges of the ulcer.
2. The ulcer is serpiginous in outline, and usually has violaceous edges, with fistulous openings in the mucosa nearby. These features can be seen by the gastroscopist.
3. Tubercles in the adjacent mucosa are frequently visible to the gastroscopist.
4. Gastric motility is disturbed less than by a malignant lesion of similar magnitude. This is judged by the roentgenologist.

In the absence of gastric tuberculosis the stomach of the tuberculous patient frequently shows gastritis and depressed secretory activity.—*Lois Cowan Collins, M.D.*

Zettergren, Lennart. Does any genetic connection exist between pyloric hypertrophy in infants and in adults? *Acta chir. Scandinav.*, 1949, *97*, 533–543.

Much has been written about adult pyloric hypertrophy in recent years. This condition can be detected in a higher percentage of postmortem studies than in roentgenologic examinations, since the roentgenologist often discovers the disease only at its full development. In many instances the roentgen interpretation will be carcinoma or ulcer. To aid in the differential interpretation, some charactreistic findings listed by Andersen and co-workers should be borne in mind:

1. Variations in the width of the constricted part.
2. The absence of irregular erosions.
3. A contrast-filled cleft between the pyloric sphincter and the rest of the hypertrophied area.
4. The presence of the mucosal folds.
5. A small, palpable, mobile tumor.
6. A rounded, mushroom-like defect in the base of the bulb.

The etiology and pathogenesis of both the infantile and adult forms of pyloric hypertrophy remain somewhat obscure. The infantile form is often termed "congenital," but this concept is weakened by the work of Runström, who found 5 children with entirely normal upper gastrointestinal studies at three to six days after birth, who returned at a later period with typical pyloric hypertrophy.

Two opposing views are held in regard to the pathogenesis of adult pyloric hypertrophy. The first of these maintains that it is a persistent infantile form, and the second supposes it to be an entirely independent morbid condition.

The author maintains that pyloric hypertrophy in an adult has no genetic connection with the infantile form. His convictions in this regard arise from the following arguments:

1. It would be unusual for a disease acquired in early infancy to proceed without any symptoms whatever up to the age of fifty to sixty years, only then to reveal signs of its presence.

2. The roentgen picture is strikingly typical in the infantile form of the disease, but may be extremely variable in adult hypertrophy.

3. The work of Monrad and others indicates that infantile hypertrophy, treated conservatively, will disappear with advancing age.

4. Several patients, following a history of hydrochloric acid ingestion, showed typical pathological changes of adult pyloric hypertrophy. A majority of cases of pyloric hypertrophy in adults disclose signs of chronic gastritis. Zettergren holds that the similarity between the hypertrophies arising from the acid gastritis and the more essential ones speak in favor of a pathogenesis common to both. He thereupon indicates that chronic gastritis constitutes the source from which adult pyloric hypertrophy originates.—*E. C. Lasser, M.D.*

Sachs, Allan E. Extrinsic duodenal obstruction in the newborn. *Ann. Surg.*, Jan., 1950, *131*, 117–123.

Three cases of extrinsic duodenal obstruction are presented. In the first case an adhesive band accompanying an anomalous artery originated from the mesenteric root just over the pancreas and extended into the duodenal-hepatic ligament. It compressed the anterior duodenal wall producing obstruction and dilatation of the stomach, proximal duodenum, common bile duct, and gallbladder. The liver showed evidence of obstruction. Roentgenologically, a trickle of barium was seen to pass the site of obstruction in the duodenum.

In the second case was shown a malrotation of the gut with volvulus of the small intestine. The left-sided cecum with adhesions attached to the peritoneum in the subhepatic area compressed the third part of the duodenum. This obstruction was demonstrated by roentgenographic means.

In the third case, a malrotation of the intestine with adhesions of the cecum and ileum to the duodenum was seen. Curling of the appendix about the second part of the duodenum produced the obstruction. This incomplete obstruction was seen roentgenologically.

Malrotation must be considered in (1) small bowel volvulus and, (2) duodenal obstruction. In malrotation, the ileum and jejunum are suspended from almost the same point, allowing twisting to occur easily.

Surgical intervention need not be feared despite the young age of these patients. The author presents details of the surgical management and supportive therapy.—*K. L. Krabbenhoft, M.D.*

Köhler, Rolf. Prolapse of redundant gastric mucosa into the duodenum. *Acta radiol.*, Jan., 1950, *33*, 69–82.

Prolapse of redundant gastric mucosa is a condition which was first described in 1911. The etiology is not entirely clear. The author shares Scott's theory as to the mode of origin. He does not believe that gastritis features in its production. He believes that the prolapse occurs as the result of abnormal gastric peristalsis secondary to stretching and loosening of the fibers in the submucosa. Abnormal nervous or chemical stimuli are thereby set up.

The clinical symptoms, if present, are similar to those found in gastritis or ulcer. Bockus writes, "Moderate redundancy of the pyloric mucosa is probably not uncommon but, unless it is associated with severe gastritis or actual prolapse of the gastric mucosa into the duodenum in sufficient quantity to interfere with evacuation of the stomach contents, symptoms are not produced."

Diagnosis and Roentgen Findings. The prolapsing gastric mucosa causes lobulated filling defects in the basal part of the bulb. The pyloric canal is often very broad.

These filling defects vary in size and shape from one examination to another. Prolapse of the gastric mucosa should not be confused

with a single gastric ruga which normally and frequently forms a small, central defect immediately adjacent to the pylorus at the base of the bulb.

Peristalsis is usually increased in prolapse of redundant mucosa. This is probably caused by the neuromuscular and neurovascular state of irritation which probably precedes the onset of this condition.

The prolapsing mucosa may be the site of an ulcer.

No retention was found in the author's cases. On the contrary, evacuation of the stomach was accelerated.—*Mary Frances Vastine, M.D.*

Forrester-Wood, W. R. Giant hypertrophic gastritis; a survey of the literature and record of a case treated surgically. *Brit. J. Surg.*, Jan., 1950, *37*, 278–282.

The author reports a case of giant hypertrophic gastritis and reviews the literature, where only about 40 cases have been recorded. This very rare disease of unknown etiology is characterized by marked enlargement of the gastric folds, and may involve only a segment of the stomach or the entire area from cardia to pylorus. The condition may be mistaken for malignant disease unless certain features of it are very clearly demonstrated roentgenographically. Large rounded filling defects protruding into the lumen of the stomach, especially along the greater curvature, are characteristic of the disease. These defects are produced by the enormous hypertrophy of the mucosal folds which grossly may resemble the cerebral convolutions. The deep sulci between the hypertrophic folds are often difficult to demonstrate. The disease must be differentiated from multiple polyposis. Gastroscopy is also of value in making a positive diagnosis.

The patients have few symptoms, if any, comprising mild indigestion, weight loss, anorexia and anemia. The treatment is surgical, consisting of resection of the stomach or involved area—if the disease is of the localized type.—*George P. Keefer, M.D.*

Melamed, Abraham. Etiology and pathogenesis of prolapsed gastric mucosa into the duodenum. *Am. J. Digest. Dis.*, Jan., 1950, *17*, 4–10.

The author reports on 50 consecutive cases of prolapsed gastric mucosa observed in three years. Next to duodenal ulcer it is the most common upper gastrointestinal disorder. The ages in the series ranged from seventeen to sixty-nine; the incidence of men to women was 4 to 1. Illustrations of the roentgen findings are given in several cases.

Most commonly noted in a prolapse involving the entire circumference of the stomach is the mushroom or cauliflower defect at the base of the duodenal bulb. Among associated lesions, generalized hypertrophy of the mucosal pattern was the most common, with 17 cases.

A review is made of the literature concerning the etiology and pathogenesis of the condition, a number of theories being given. There are actually numerous etiological factors, the author believes; he gives a classification of these. He considers hypermobile rugae as a primary cause, pointing out that it has been shown that the mucosa of the stomach is capable of movement independent of that of the muscularis, thus making prolapse into the duodenum possible where hypermobility exists. Another possible primary cause given is redundant, hypertrophic rugae. Of secondary causes the author lists antral gastritis, hypertrophic gastritis and possibly peptic ulcer. Among the inflammatory lesions, antral gastritis is the the most important. In his series 9 cases (18 per cent) had co-existing peptic ulcer; therefore, he considers this as a possible etiological factor. Among secondary causes are also listed systemic conditions, such as congestive heart failure where submucosal and mucosal edema of the stomach can give rise to slipping of the mucosa into the duodenum. The lesion may be reversible as the systemic condition improves. Hypoproteinemia or reversal of the albumin-globulin ratio gives similarly edematous and pendulous folds, conducive to prolapse. The author cites a case of carcinoma of the esophagus with stenosis in which he believes the prolapse could be explained on this basis (i.e., hypoproteinemia). Idiopathic pyloric hypertrophy is another condition which has been reported as an etiological factor. A neurogenic factor also has been said to be of importance. Several of the author's patients have had exacerbations apparently resulting from emotional disturbances. Vitamin deficiency and trauma are given as questionable factors. One case is given of lymphatic leukemia with co-existing prolapse, raising the question of a possible etiological relationship due to leukemic changes in the mucosa or submucosa. The danger of carcinomatous degeneration

in cases of prolapsed gastric mucosa should be borne in mind, one such case having been reported in the literature.

Much epigastric distress may be present in severe cases, sometimes with vomiting, black stools, weakness and weight loss. Three of the 50 cases went to surgery because of the severity of the symptoms. Cure resulted after a resection of the redundant gastric mucosa; in the one case, ischemic necrosis had resulted in two ulcers with an almost fatal hemorrhage. The microscopic findings are given in each of the surgical cases.—*J. P. Bennett, M.D.*

Cattell, R. B., and Ludwig, J. P. Premalignant lesions of the ampulla of Vater. *Surg., Gynec. & Obst.*, Jan., 1950, *90*, 21–30.

The authors have surveyed all the so-called "tumors of the pancreas" which came to surgery at the Lahey Clinic from January 1, 1942, to January 1, 1949. They numbered 175 cases and of these 165 included carcinomas of the ampulla, head, body and tail of the pancreas, duodenum and lower common bile duct. The remaining 10 tumors were benign. Two of these were diagnosed preoperatively as carcinomas of the ampulla. At surgery, they were found to be benign papillomas of the ampulla. In the carcinoma series, 59 radical resections for carcinoma of the head or ampulla, duodenum or lower common bile duct were performed. In 4 of these the carcinoma was believed to have originated in an ampulla lesion considered premalignant such as a papilloma, polyp or adenoma.

The 2 cases of benign papilloma of the ampulla and the 4 cases of carcinoma originating in a benign lesion in the ampulla are presented in detail in order to emphasize the importance of these lesions in this location. It is shown that (1) such lesions produce symptoms of obstruction of the common bile duct, (2) are relatively common, (3) are premalignant and (4) the malignancy which arises in them may be curable by radical pancreatoduodenectomy.

The presence of one of these benign lesions should be suspected in the patient who, having had a cholecystectomy, experiences recurrence of symptoms.—*Mary Frances Vastine, M.D.*

Cantor, Meyer O. Physics in intestinal intubation. *Am. J. Digest. Dis.*, Jan., 1950, *17*, 10–11.

The author discusses the main types of tubes used for intubation, describing a simplified tube which has as its propulsive mechanism mercury confined within a loose balloon attached to the tip of the tube. He states that the balloon in this way utilizes all the physical properties of the mercury, an unrestricted flow of the mercury within the balloon being permitted. Increasing the number of holes in any intestinal decompression tube increases its efficiency wherever the intra-abdominal pressure is a major factor in forcing the intestinal contents into the tube. The intra-abdominal pressure added to the pressure exerted upon the lumen of the bowel by the contracting efforts of the bowel wall exerts considerable force upon the intestinal contents forcing them into the holes in the tube regardless of the number. Increasing the size of these holes also increases the efficiency of the tube, making it easier for the intestinal contents to enter without plugging. Galileo's law for free-falling objects does not apply in the simplified intubation tube since here there is the resistance of the sphincters to overcome and the tube-head must pull a tube behind it. In such cases, increasing the amount of the mercury in the tube-head definitely increases the speed of intubation.—*J. P. Bennett, M.D.*

Kositchek, Robert J., and Rabwin, Marcus H. Massive resection of the small bowel for adenocarcinoma of the jejunum. *Am. J. Digest. Dis.*, Jan., 1950, *17*, 13–17.

The authors give a case report in which the patient had three years previously first noted symptoms of nausea and emesis, being later treated for anemia. Fatigue and loss of weight developed and increased. Various physicians were consulted, four roentgen studies of the stomach and colon being made, all of which were negative. When the authors were first consulted they found a palpable lemon-sized tumor mass to the left of the umbilicus. Anemia was pronounced with poikilocytosis and anisocytosis. Blood (4 plus) was found in the stool. Roentgenograms revealed considerable spasticity in the first part of the jejunum with narrowing noted on one of the films with moderate dilatation proximal thereto corresponding to the palpable mass. Surgery revealed an adenocarcinoma of the first part of the jejunum completely obstructing the small bowel with extensive marked dilatation of the jejunum proximal to the mass. Considerable glandular involvement was present. A radical resection was done with an end-to-end anastomosis of the

duodenum to the ileum within 8 inches of the ileocecal junction. The specimen removed was 86 inches or about 90 per cent of the total length of the small bowel, which was unusually short. The authors discuss the postoperative management which was complicated by the marked decrease of digestive enzymes and of the absorptive surface of the small bowel. A satisfactory nutritional state was attained and maintained and the patient improved, the blood count also rising. Laboratory studies are given.

The patient later became edematous, death occurring somewhat less than six months after surgery. Autopsy revealed extensive metastases to the liver with lymph node involvement behind the anastomosis and in the left retroperitoneal area. The author points out that had this surgery been done for a benign lesion, the patient could probably have been maintained in fair health indefinitely despite the extensive resection, thus encouraging such resections in cases of extensive mesenteric trauma, volvulus. intussusception, regional ileitis, etc., where a major portion of the small bowel is diseased or devitalized.—*J. P. Bennett, M.D.*

Fleischner, F. G., and Bernstein, C. Roentgen-anatomical studies of the normal ileocecal valve. *Radiology*, Jan., 1950, *54*, 43–58.

The authors report a comparative roentgen-anatomical study of the ileocecal valve on the basis of 50 normal postmortem specimens and selected roentgenograms from approximately 2,000 clinical examinations.

Many variations in the morphology of this region were encountered. The prevailing pattern presented the following roentgenographic pattern. The terminal ileum rising from the pelvis in a reverse S-slope is implanted into the medial colonic wall, projecting into the colonic lumen for 2 cm. This intracolonic area, representing the valve itself, is flattened so that it forms a wedged-shaped lumen, opening through a horizontal slit into the colon. The upper and lower walls of this flattened area are the upper and lower lip of the valve, seen as band-like negative shadows, 3–5 mm. in width, converging toward the center of the colon. The barium-filled area between the lips varies from an elongated evenly calibered channel to a short plump one.

The lateral wall of the terminal ileum and the medial wall of the cecum may be fused over a fairly long distance. If the spacing between ileum and cecum is even in width, with both contours smooth and parallel, this is considered a normal variation rather than the result of inflammatory adhesions.

An excessive accumulation of fatty tissue in the lip of the valve or protrusion of ileal mucosa beyond the lip of the valve, may cause a rounded tumor-like defect in the colon.

Persistently visible Kerkring's folds in the terminal ileum occur with disease in the ileocecal region and their presence should arouse suspicion of the presence of an associated lesion. —*J. J. McCort, M.D.*

Lowe, Charles U., May, Charles D., Stauffer, Herbert M., and Neuhauser, E. D. B. Fibrosis of the pancreas. *Am. J. Dis. Child.*, Jan., 1950, *79*, 91–98.

Studies on patients with fibrosis of the pancreas were carried out for two purposes: (1) to discover, if possible, an acceptable physiologic explanation for the ravenous appetite of these patients and its abatement with the administration of dried pancreas, and (2) to determine whether the pancreas is or is not involved in the production of an enterogastrone-like substance which might play a role in the "duodenal mechanism" of Gershon-Cohen.

The following are the authors' conclusions:

1. In normal subjects, orally administered fat results in delayed gastric emptying.

2. In patients with fibrosis of the pancreas the feeding of fat does not have this effect.

3. When pancreatin U.S.P. is fed to patients with fibrosis of the pancreas thirty minutes before a meal with fat, delayed gastric emptying results.

4. The interrelation between the normal pancreas, enterogastrone and the "duodenal mechanism" is discussed. It is proposed that these relations may explain the increased appetite observed in patients with fibrosis of the pancreas and its relief by administration of pancreatin.

5. The "deficiency type" roentgenographic pattern was present in the bowel of normal subjects following a meal with fat, but in patients with fibrosis of the pancreas, feeding of fat did not produce this effect except after administration of pancreatin. A possible explanation for this observation is advanced.

In their comment on their results, the authors suggest that a logical explanation, particularly in view of the work of May and McCreary, who could frequently erase the "clumping pattern" in patients by administration of methacholine

(mecholyl) chloride, is that this intestinal picture is due to the hormone responsible for the "duodenal mechanism." The patient with steatorrhea has residual fat in his intestine at all times, and therefore when barium sulfate is administered one observes the intestinal pattern which normally is present only following the feeding of fat. However, the response per se is due not to the presence of fat but rather to the hormonal effect it has engendered.—*R. S. Bromer, M.D.*

Bigelow, Robert, and Clark, Dwight E. Heterotopic pancreatic tissue and gastric mucosa in Meckel's diverticulum. *Arch. Surg.*, Jan., 1950, *60*, 157–163.

The authors present the 31st reported case of aberrant pancreas in a Meckel's diverticulum and the 8th in which the diverticulum contained both gastric and pancreatic tissue.—*George Cooper, Jr., M.D.*

Åkerlund, Åke, and Rudhe, Ulf. Intramural small-cystic diverticulosis of the gallbladder. *Acta radiol.*, Feb., 1950, *33*, 147–164.

Intramural small-cystic diverticulosis in the gallbladder wall, due to a lack of muscle in the mucosa and the absence of a submucosa is a common cause of impaired emptying of the gallbladder. The condition, in its microscopic initial stages, may be considered as physiologic in middle aged and elderly persons.

These diverticula have been given a multiplicity of names, viz., "glands," "ducts," "crypts," "sinuses" and usually combined with a proper name, viz., Malpighi, Ruysch, Luschka, von Rokitansky, Aschoff. They have often been confused with other structures in the gallbladder wall such as mucus glands and aberrant biliary ducts.

They appear to be an essential feature in a number of conditions such as cystic cholecystopathy, cystic cholecystitis, cholecystitis glandularis proliferans, adenoma, cystadenoma and adenomyoma of the gallbladder. The writers believe that the term small-cystic intramural diverticulosis is preferable to any other because it characterizes adequately the process of herniation or invagination of the mucosa in the deeper layers of the wall with secondary, peripheral, cystic dilatation.

Although intramural diverticulosis is a common pathologico-anatomical finding it is seldom demonstrable roentgenologically with our present technique. The authors' observations in conjunction with 2 cases encountered in the literature are the bases of a new roentgen finding typical of intramural diverticulosis. The finding consists of a more or less continuous, narrow streak of contrast immediately adjacent to the shadow of the gallbladder and following it for varying distances. This contrast or corona shows in places a suggestion of granulation or columnar structure. The roentgenologic appearance is due to the effect caused by the contrast filling of a large number of closely packed intramural diverticula.

The importance of diverticulosis of the gallbladder in the origin of the aseptic cholesterol concretions of radiate structure in the retention gallbladder is stressed.—*Mary Frances Vastine, M.D.*

Chiray, M., Debray, C., and Delattre, P. La lithiase biliaire des jeunes. (Biliary lithiasis in young individuals.) *Acta gastro-enterol. belg.*, Feb., 1950, *13*, 89–99.

While in young individuals, biliary lithiasis may appear in the same pattern as in adults, certain characteristics are often peculiar to youth. Clinically, presenting symptoms appear before the age of thirty and predominantly in the female. Frequently there are associated neurovegetative and endocrine (particularly ovarian) disorders. Hepatic colic is rare but dyspepsia common.

Roentgenologically, the gallbladder fills and empties adequately; concentration is satisfactory. It contains calculi which are radiotransparent and primarily cholesterin.

Anatomically, the gallbladder is flexible and its walls are normal. There is no cholecystitis. Histopathologically, there is no significant change.

In the medical treatment, attention is paid to the neurovegetative and endocrine difficulties. If surgery becomes necessary, cholecystostomy would seem to be the operation of choice since the gallbladder is anatomically and functionally healthy. Cholecystectomy is indicated only if the gallbladder wall is diseased or if, by radiometric examination, there is disease of the neck of the gallbladder. Medical care must always follow surgical intervention.—*M. L. Sussman, M.D.*

Cocchi, Umberto. Die nichtgefüllte Gallenblase. Ein Beitrag zur Röntgenkontrastdarstellung der Gallenblase nach Wasserstoss oder Karlsbader Salz. (The non-filling of the

gallbladder; a contribution to the roentgen contrast visualization of the gallbladder following water impetus or Karlsbad salt.) *Acta radiol.*, Feb., 1950, *33*, 115–129.

The author lists the various conditions which may lead to a non-filling of the gallbladder in cholecystography. In general, they are either of organic or reflex nature.

He then analyzes the series of 217 cases of Hotz in which cholecystography with oraltetragnost has been performed. A good filling of the gallbladder was obtained in 123 cases (56.7 per cent) and a non-filling in 94 cases (43.3 per cent). Of the 217 cases, 82 were operated upon at the Surgical Clinic of the University of Zürich. Among these, 25 had a good filling, 8 a poor filling and 51 a non-filling of the gallbladder. Of considerable interest is the fact that in 6 per cent of the cases with non-filling, a normal gallbladder was found at the operation. Similar observations were made by other investigators, the error, as indicated in the literature, varying between 4 and 10 per cent.

One may slightly reduce this error by repeating the examination or by using different contrast media. The author suggests an additional procedure which is described in the present article.

Stimulated by the experimental results of the Italian investigators (Benassi in 1928, Vitale in 1937), the author for the last few months has administered perorally ordinary tap water and later Karlsbad salt in all cases with non-filling of the gallbladder. The detailed procedure is as follows: the evening before the examination the patient is given perorally iodobil or priodax. The next morning, that is about thirteen to fourteen hours after partaking of the dye, the first roentgenogram is taken with the stomach empty. If there is non-filling or only a faint visualization of the gallbladder, the patient is given to drink 200 cc. of ordinary tap water and ten minutes later a second roentgenogram is taken. One may give instead of tap water a teaspoonful of Karlsbad salt dissolved in 50 cc. of water. After the second roentgenogram two egg yolks are given and a third roentgenogram is taken forty minutes later.

The procedure was carried out in 91 cases, in 57 with tap water and 34 with Karlsbad salt. Two effects were noted. First, an improved opacification was obtained in 31 per cent of the cases, this permitting a demonstration of formerly non-visible stones in 6.8 per cent of the cases. Second, a decrease in the size of the gallbladder, corresponding to an average of 0.6 cm., was noted in 60 per cent of the cases, although this was not always associated with an increase of opacification. The additional administration of the egg yolks produced a contraction of the gallbladder, corresponding to an average of 1.8 cm., in 91.4 per cent of the cases. The author states, however, that he has never observed a visualization from the egg yolks in case of non-filling of the gallbladder, as mentioned by Becchini.

The theory is advanced that the sudden increase in the intra-abdominal tension by the impetus of the water or the water-dissolved Karlsbad salt acts on a reflex basis on the gallbladder producing an increase of its tonus which then leads to a better opacification and an enhanced contraction.—*T. Leucutia, M.D.*

GYNECOLOGY AND OBSTETRICS

Granjon, A., and Beau, A.-M. A propos des grossesses dites angulaires. (Concerning so-called angular pregnancy.) *Gynéc. et obst.*, Jan., 1950, *49*, 28–43.

This paper deals with pregnancy occurring in bicornate uterus, defined by Devraigne as "implantation of the ovum in a uterine horn." The authors enter into considerable discussion regarding nomenclature and conclude that "pregnancy called angular" is actually a cornual pregnancy or pregnancy in a malformed uterus.

They point out that the chief symptoms indicating such diagnosis clinically consist of upward and outward enlargement of the uterus, a ridge between the visible mass and the other portion of the uterus, and presence of a round ligament at the external pole. The complications of pregnancy arising in such a uterus consist of partial separation of the ovum with hemorrhage, repeated abortions, premature labor, spontaneous rupture of the pregnant uterus, and accidents of delivery, chiefly hemorrhage, abnormal adhesions, and retention of the placenta.

In patients giving history of pregnancy as described above, it is necessary to investigate the cause and, in the authors' opinion, a definite diagnosis can be made only by hysterography. They point out that the procedure should be carried out only when the patient is not pregnant.

They cite 5 cases in patients who had one or more premature deliveries or abortions, all with malformed uteri of the bicornate, unicervical type. The uterine anomalies were

demonstrated by hysterography. In a sixth case it was possible to make a differential diagnosis, and to exclude bicornate uterus. Diagnosis of pregnancy in uterine horn was made by her attending physician after four months of amenorrhea. However, she was seen by the authors when five months pregnant, and they detected a mass on the right side, but the uterus was perceptible on the left side, was not enlarged and the Aschheim-Zondek test was negative. Hysterography and concomitant cystography showed displacement of a malformed uterus by a mass which proved to be an ovarian cyst. If pregnancy had been present, the patient's history and the findings could have led to the diagnosis of "angular" pregnancy.

There are seventeen excellent roentgenograms and an extensive bibliography.—*Angus K. Wilson, M.D.*

Jeaffreson, Bryan L., and Nathan, Nestor J. S. Secondary abdominal pregnancy. *J. Obst. & Gynaec. Brit. Emp.*, Feb., 1950, *57*, 65–67.

The authors report a case of secondary abdominal pregnancy in which the diagnosis was suggestive at the clinical examination and which was confirmed on hysterosalpingography. The authors emphasize the longitudinal position of an extra-uterine intra-abdominal pregnancy as an aid in diagnosis. Attention is drawn to the severe postoperative symptoms and signs usually occurring in these cases and which have not previously been reported in the literature. The treatment is summarized.—*Moris Horwitz, M.D.*

León, Juan, and Obiglio, Julio R. Monstruo doble (sisomiáno esternodimo); a propósito del diagnóstico radiológico de los monstruos dobles. (Double monster [syssomus sternodymus]; concerning the roentgenologic diagnosis of double monsters.) *Rev. de ginec. e d'obst.*, Feb., 1950, *44*, 89–96.

The intrauterine diagnosis of fetal anomalies and monstrosities has advanced considerably. In his two textbooks entitled "La radiología en obstetricia" and "Sémiología obstétrica" one of the authors (León) listed the following conditions in which roentgen examination by means of simple roentgenograms, soft tissue roentgenograms and amniograms may contribute to the ante partum diagnosis: hydrocephalus, anencephalus, myelocele, meningocele, absence of the sella turcica, spina bifida, rachischisis of the cervical column, teratoma of the pelvis, reduced number of ribs, osteogenesis imperfecta, generalized hydrops, intrauterine ascites, symmelian monsters, etc. A review of the literature shows, however, that there are only a few cases of double monsters described in which roentgen examination permitted the condition to be recognized ante partum.

The authors report a case of double monster which was delivered one month prematurely through the natural route by manual extraction, one of the lower extremities having been torn away. The monster was a katadidymus with union of the body of the two fetuses at the pelvis at the expense of the iliac bone (syssomus) and at the manubrium sterni (sternodymus). The photographs of the monster in various views and the roentgenograms in utero and after delivery are reproduced.

The following roentgen diagnostic criteria are established: (1) the homologous poles of the double monster are located in the same uterine zone, as for example, two fetuses in breech presentation; (2) the two heads are rather close to each other, except in the derodidymus type in which the two fetuses are united by looser structures, thus permitting a wider separation of the heads; (3) the two fetuses are united in homologous planes, as for example, the two backs, the anterior surfaces of both thoraces, etc.; (4) there are two vertebral columns, which in the syssomus monster are separated in the cervical region and approximated in the lower dorsal, lumbar or sacral regions, although additional roentgenograms in the frontal and posterior oblique views may be necessary to demonstrate that this approximation is marked and constant; (5) in the syssomus monster there is one single fetal pelvis; (6) in certain varieties there are only two upper or two lower extremities; and (7) the ribs are often fused. Graber mentions two additional criteria, which, however, are less reliable. One of these is the fact that the head of one of the fetuses does not face the front of its body but is in extension and the other is that the hand of one of the fetuses rests on the shoulder of the other, indicating that both are in the same amniotic sac.

The roentgenologic diagnosis of double monsters is important since it permits the avoidance of the risk of a delivery via the natural route.—*T. Leucutia, M.D.*

Anderson, A. F. The diagnosis of early carcinoma of the cervix uteri and its implications.

J. Obst. & Gynaec. Brit. Emp., Feb., 1950, *57*, 1–9.

The term "early carcinoma" includes the pre-invasion type (incipient, intra-epithelial, or carcinoma in situ) and the type with early invasion into the cervical connective tissue. The authors present 3 cases with suspicious cervical biopsies who eight years, four years, and fifteen months later were examined and found to have invasive carinoma of the cervix. They feel there can be little doubt that this type of cancer has a longer life cycle than is generally realized and that the clinically recognizable cancer is always an old cancer.

The implications are that we must introduce some means to find these early cancers and accept the responsibility of looking for them before they cause the textbook symptoms and signs and lower our idea of the average age of cancer of the cervix. As a solution to the problem, they suggest that the clinical pathologists examine many more sections of any specimen raising suspicion and of a ring cut from the mucosal junction of any cervix sent for routine examination, with or without the uterus. To the clinician they recommend (1) the efficient following of any patient whose biopsy raised suspicion, even if further sections prove negative, (2) not to discharge a patient on the strength of a negative biopsy when a positive report has previously been given, and finally (3) that a sample should be obtained of the junctional tissue of every cervix seen in the operating theater and the out-patient clinic.—*W. C. MacCarty, Jr., M.D.*

GENITOURINARY SYSTEM

Orkin, L. A. Evaluation of the merits of cystoscopy and retrograde pyelography in the management of renal trauma. *J. Urol.*, Jan., 1950, *63*, 9–24.

Adequate diagnosis is essential in cases of kidney trauma in order to determine the necessity of operative intervention. Excretory urography has been advocated as the most applicable and safest method of study in the problem. Although even this method is not advocated in cases of shock, the author used it in 2 such instances and obtained satisfactory visualization of the kidneys. The author reports on a series of 37 cases of renal trauma, in 32 of whom intravenous urography was performed. The pyelograms were considered to be diagnostic in 40 per cent. In 9 of these 13 diagnostic pyelograms the kidneys were considered normal. In 4 of these 9 cases subsequent study proved that severe rupture of the kidney existed. The author concludes as a result that all cases of renal trauma should have retrograde studies even though intravenous studies show apparently normal kidneys.

In 9 cases no visualization of dye was obtained on the injured side. This non-visualization has been accepted in the past as evidence of severe renal injury and the probable indication for surgery. In the author's series 6 of these 9 cases were subsequently proved to have no serious injury such as rupture which means that non-visualization cannot be considered as evidence of rupture or injury requiring surgical intervention. In these cases retrograde study was of great value in ruling out rupture where non-visualization occurred by intravenous study.

The most important value of intravenous study was to reveal a functioning kidney on the uninjured side and to rule out hypoplasia of the uninjured kidney as well as to demonstrate the presence of a congenital solitary kidney.

The author concludes that preliminary intravenous study is advisable to demonstrate the presence and condition of the kidney on the uninjured side but that retrograde pyelograms are essential to determine the severity of the injury on the affected side. He also feels that the study of the bladder at cystoscopy is of added value. The author considers the arguments which have been advanced against the performance of cystoscopy and retrograde pyelography early in cases of renal trauma and does not feel that they are valid. He feels that the benefits to be gained by early cystoscopy and retrograde pyelography far outweigh the possible harmful effects. He recommends performance of intravenous urography at once even though the patient is in shock and at the bedside if necessary.—*R. M. Harvey, M.D.*

Musiani, Umberto, and Pollastri, Sante. Sul "letargo" del rene. (On the lethargy of the kidney.) *Arch. ital. urol.*, 1950, *24*, 69–75.

The name "lethargy" of the kidney is used to designate a temporary suspension of the function of this organ followed after a shorter or longer period by a complete resumption of the function. Dourmashkin applied the term of "renal hibernation." A review of the litera-

ture made by the authors shows that the condition occurs almost exclusively in obstruction by ureteral calculi.

In the present article the authors report a case in which the lethargy occurred under different conditions. The case is that of a barber thirty-eight years of age who since the age of twenty had three operations on the right kidney, because of recurrent stones. Prior to the last operation a urinary abscess developed which spontaneously opened through the lumbar region. Retrograde pyelography revealed advanced hydroureter and hydronephrosis on the right side complicated by perinephritis. In performing a nephrectomy great difficulty was encountered so that a hydropyonephrotic pocket located high under the diaphragm had to be left behind. The lumbar fistula persisted for five months after which time it closed spontaneously. After another five months a recurrent lumbar abscess developed which likewise opened spontaneously. Roentgenography revealed several calcareous deposits in the upper portion of the right renal bed. These were removed and the patient placed on penicillin therapy. The urinary excretion, which had completely ceased for five months, had now reappeared and again kept the lumbar fistula open. Finally, after an additional five and a half months, a radical operation with resection of the twelfth rib was done and the residual hydronephrotic pocket, which was the size of a small orange, was extirpated. A complete recovery with closure of the fistula followed.

The authors suggest the following theory for the explanation of the rather long suppression of the renal function: Based on Trueta's recent studies of the renal circulation they assume that the calcareous deposits produce a reflex vasoconstriction of the peripheral part of the interlobular arteries leading to ischemia of the kidney cortex with the result that the blood after passing through a few juxtamedullary glomeruli is shunted directly into the venous current. Thus a sufficient circulation is present to preserve the vitality of the organ but no urinary excretion takes place. After removal of the stones the reflex action ceases and the urinary excretion is resumed.—*T. Leucutia, M.D.*

Thorsen, Gunnar. Pyelorenal cysts. *Acta chir. Scandinav.*, 1949, *98*, 476–488.

Solitary cystic formations communicating with the renal pelvis are relatively rare. Krogius, in 1904, reported 10 cases, from which he concluded that these cysts were of congenital origin. Thorsen disagrees with this concept, stating that since 1893 only 11 cases of solitary renal cysts in children have been reported, and of these none were found to communicate with the renal pelvis. The author is of the belief that these pyelogenic cysts arise during the latter part of life in four ways: (1) through perforation into the renal pelvis from a renal or pararenal cyst; (2) through rupture of the kidney; (3) through ectopy of a part of the kidney; (4) through atrophy of the renal parenchyma about a single calyx, with subsequent cystic dilatation.

Pyelorenal cysts are located most commonly in the upper or lower pole of the kidney and appear to be somewhat more common in women. The diagnosis depends entirely upon the roentgen examination. Differentiation from tuberculous cavities will usually depend upon the clinical findings, while differentiation from renal abscesses with perforation into the renal pelvis and renal cysts of some other origin will be more difficult, and, in many cases, impossible.

The author reports 2 cases of pyelorenal cysts he had observed. The first of these occurred in a woman aged thirty-eight, who had had one kidney removed previously because of pyonephrosis. Roentgen examination in this case showed a great many calcifications in the lower portion of the left kidney. These changed positions with change in the position of the patient. Retrograde urography showed a rounded cavity connected with the lowest calyx through a narrow neck about 1 cm. long. Review of earlier roentgenograms showed that the cyst was found in the same place ten years earlier at which time the concretions were present, but were thought to be mesenteric gland calcifications. Extirpation of the cyst was carried out, uneventfully.

The second case reported by the author occurred in a woman, aged twenty-one. In this case a club-shaped cystic distention of the lower calyx on the right side was noted, which remained unchanged over a ten year period of observation. This was thought to be the first phase of development of a pyelorenal cyst.—*E. C. Lasser, M.D.*

Israels, Sydney, Muth, H., and Zeavin, I. Nephrolithiasis with renal tubular failure. *Am. J. Dis. Child.*, Sept., 1949, *78*, 389–392.

The authors state that failure of a single

function of the renal tubules has been a well recognized entity. Albright and his co-workers reported 9 cases of nephrolithiasis and nephrocalcinosis in which they demonstrated that the primary defect lay in the inability of the renal tubules to form ammonia. This resulted in the loss of fixed base, with precipitation of calcium salts in the tubules and renal pelves. Loss of fixed base other than calcium may occur; potassium deficiency with resulting paralysis has been reported in a case of chronic nephritis in which tubular formation of ammonia had failed.

The case reported showed many of the features of those described by Albright and his associates. The authors find it difficult to understand why the roentgenograms of the patient failed to show bone changes suggesting rickets. Albright attributes this failure to the fact that the serum phosphorus failed to fall to a low level. This, in turn, in his opinion, was due to the fact that the loss of calcium in the urine was being taken care of by an adequate calcium intake and absorption. Hence, lowered serum calcium levels failed to occur and parathyroid activity was not stimulated to lower the phosphorus level.—*R. S. Bromer, M.D.*

Gaudin, H. Fatal embolism following urethrography. *J. Urol.*, Sept., 1949, *62*, 375–377.

The author reports the case of a sixty-one year old man who had had urinary difficulty for two years following a hernia repair. The contrast medium used to perform urethrography was a 40 per cent suspension of barium in a 0.5 per cent gum acacia solution in water. The medium was injected under pressure less that 100 mm. of mercury, controlled by a sphygmomanometer bulb. Ten minutes following the injection the patient got down from the table, complained of faintness and died ten minutes later. Roentgen films exposed at the time showed the medium throughout the cavernous bodies, the corpus spongiosum and the veins of the pelvis. The medium was proved at autopsy to have entered the circulation through a false passage in the urethral wall distal to a stricture.

The author advises the use of the intravenous media for urethrograms to prevent the possibility of embolic phenomena.—*R. M. Harvey, M.D.*

Jackson, A., Bates, G. C., Slavin, M., and McFarland, M. D. Renal osteodystrophy associated with diabetes mellitus; congenital polycystic hypoplasia of the kidneys and polycystic disease of the pancreas. *Arch. Int. Med.*, Jan., 1950, *85*, 11–26.

The authors report a case of renal osteodystrophy in a twenty-five year old white male with diabetes mellitus and chronic azotemia. The clinical findings as well as the laboratory data and roentgen findings and the progress of the case are discussed in detail. The autopsy findings are then given. At autopsy the patient was found to have congenital polycystic disease of the pancreas which accounted for the diabetes mellitus. He also had congenital polycystic hypoplastic kidneys. There was evidence of secondary hypertrophy and hyperplasia of the parathyroid gland. The roentgen findings consisted of generalized bone decalcification with the formation of cysts in some areas in the bones. The outer end of each clavicle was involved by a rather extensive destructive process which produced bone spiculization. There was demineralization in the flat bones of the skull, vertebrae, and pelvis.

The authors discuss the etiology of renal osteodystrophy from their studies of the literature and give the etiological calssification as originally described by Rule and Grollman.

An Etiological Classification of Osteo-Nephropathy

A. Due to primary urinary tract disturbances
   1. Chronic glomerulonephritis, pyelonephritis, nephrosis.
   2. Congenital malformations: Polycystic kidneys, renal hypogenesis.
   3. Urinary tract obstruction with secondary renal lesions: Urethral valves; enlargement; calculi; strictures of urethra, bladder neck or ureter; hydro-ureter.
   4. Primary tubular functional changes which may or may not show anatomical changes.
      a. Hypochloremic-glycosuric type (de Toni-Fanconi syndrome)
      b. Hyperchloremic type without glycosuria.

B. Due to primary extrarenal disturbances
   1. Endocrine disease.
      Hyperparathyroidism (osteitis fibrosa cystica)
   2. Metabolic disturbance
      Cystine storage disease.

—*G. W. Chamberlin, M.D.*

Griffiths, W. Carcinoma of the adrenal cortex; report of a case without endocrine changes. *Brit. J. Surg.*, Jan., 1950, *37*, 311–314.

This is a case report with certain significant roentgen findings. In a brief discussion of this condition, the author states that Wu in 1940 made an exhaustive search of the literature and found only 4 cases in females without endocrine changes. Loeb reported a female patient with this condition in 1941, and in 1942, Cahill, Melicow and Darby reported 2 more. In these tumors of the adrenal cortex with no associated endocrine changes, the lesion may attain considerable size before the patient presents herself with symptoms. It is pointed out that, in all patients showing calcification in the right or left hypochondrium, carcinoma of the adrenal cortex should be considered. This patient showed an area of calcification in the right hypochondrium with downward displacement of the kidney below it.—*D. S. Kellogg, M.D.*

Gustad, Viktor, and Hertzberg, Johan. Acute necrosis of the renal papillae in pyelonephritis; particularly in diabetics. *Acta med. Scandinav.*, 1950, *136*, 331–342.

Acute necrosis of the renal papillae in cases of pyelonephritis is fairly rare and almost always fatal. It is often associated with diabetes and should be recognized as an important and serious complication in elderly diabetics.

In retrograde pyelography enlargement and deformity of the calyces due to extensive sloughing of the necrotic papillae is seen. When this condition is not suspected, it may be confused with tuberculosis or tumor.

The pathogenesis of acute papillary necrosis remains obscure, but anatomical conditions play an important part. The papillae and the pyramids are not so well supplied with blood as the rest of the kidney. Also, the blood reaching the papillae must first pass through the glomeruli and the peritubular capillaries. Before reaching the papillae, the blood undergoes considerable changes, becoming more concentrated, and loosing large quantities of water, chlorides and sugar. The high-molecular proteins remain and the osmotic pressure is therefore raised. The patient often suffers from some obliterating disease of the arterial tree which further reduces their blood supply. Diabetes also seems to play a part, especially when accompanied by acidosis.

The prognosis is grave and the condition usually fatal. Occasional unilateral cases may recover after nephrectomy.

E. coli and particularly staphyloccocus infections are usually present. The condition is so serious that everything possible must be done to prevent urinary tract infection in diabetic patients.

Six cases are presented.—*Charles Nice, M.D.*

King, J. D. Spontaneous renoduodenal fistulas. *Radiology*, Jan., 1950, *54*, 82–86.

Renovisceral fistulas developing without surgical or traumatic intervention, the so-called spontaneous fistulas, are relatively uncommon. They are the result of an inflammatory process in the kidney which invades an adjacent viscus. There may first develop a perirenal abscess which ruptures into the viscus.

Six reported cases of spontaneous renoduodenal fistulas are reviewed and an additional case is presented. In the author's case retrograde urograms made five days after admission to the hospital demonstrated a fistulous communication between the right kidney pelvis and the second portion of the duodenum.

The recommended treatment is nephrectomy and fistulectomy.—*J. J. McCort, M.D.*

Mitchell, G. A. G. The renal fascia. *Brit. J. Surg.*, Jan., 1950, *37*, 257–266.

This paper may not be of general interest to all radiologists, but it does show that radiology can and does continue to play an important part in demonstrating important gross anatomy. By the use of a fine barium emulsion injected slowly through a needle into the perinephric space of the abdomen, the author has clearly delineated the renal fascial planes, and has been able to correct early less accurate descriptions of the renal fascia.

Fluoroscopy and roentgenograms made during the barium injection show that the renal fascia is formed by the splitting of retroperitoneal tissues to form a loose common investment for the kidney and suprarenal gland. Anterior and posterior layers are fused superiorly and laterally, also medially and inferiorly. The weakest spot in the renal fascia is in the region of the ureter through which perinephric effusions may escape to invade the pelvis. The two perinephric spaces are neither in actual nor potential communication.—*George P. Keefer, M.D.*

Lowsley, O. S., and Gentile, A. Urethral calculus in the male, with particular reference to giant primary stones. *Urol. & Cutan. Rev.*, Jan., 1950, *54*, 1–7.

Urethral stones are classified as (1) primary, or autochthonous, and (2) secondary, or immigratory. Secondary stones are much more common.

Primary calculi are phosphatic in composition, have no nucleus, and are uniform in structure. They are formed in the urethra, either behind some obstruction, or in a congenital or acquired diverticulum, or a cavity left after the removal of the prostate gland or by a prostatic or peri-urethral abscess. Primary stones may also form around silk sutures or a foreign body lodged in the urethra or following injury to the urethra or in an ulcerous area in the urethral wall.

Secondary stones are those which have migrated from higher up in the urinary tract and have been retained in the urethra or in a pouch opening off it. They have a definite nucelus and are composed of the constituents that make up kidney, bladder or prostatic calculi. However, when impacted in the urethra, such stones accumulate phosphatic deposits and then resemble primary stones.

In a pathological urethra, most stones are arrested above a strictured area or in a pouch communicating with the urethra. In a normal urethra, calculi are impacted behind one of the points of anatomical narrowing. The majority of calculi are found in the prostatic urethra, just behind the narrow membranous portion; the next most frequent site is in the fossa navicularis, behind the external meatus.

Urethral stones are, as a rule, solitary, but cases of very large collections of stones have been reported. Most urethral stones are small but "giant" calculi weighing from 25 grams to a record weight of over 1,000 grams have been found.

Secondary, migratory stones often are arrested and impacted in the urethra, where they produce obstruction, either complete or partial, or inflammatory changes or both, necessitating prompt treatment. The symptoms are then sudden in onset and severe: pain along the penis, partial or complete retention of urine, or if the stone is in the prostatic urethra, incontinence of urine and pain on defecation. Stones lodged in diverticula, of course, tend to cause less sudden and acute symptoms.

Primary urethral calculi, on the other hand, usually manifest themselves insidiously for years. One or more of the following symptoms may appear: perineal or penile pain; urinary frequency and urgency; hematuria; a urethral discharge; decrease in size and force of stream, which may progress to complete retention or steadily increasing incontinence.

A careful history, simple palpation of the penis, and rectal palpation are often sufficient to give presumptive evidence of urethral stone, and confirmation can be obtained by sounding, urethroscopy, or roentgenography. Treatment is also discussed in detail and is determined by location and size of the stone.

In this article the various case reports of "giant" size urethral calculi are enumerated and the authors present 2 cases of their own in detail. In 1 instance the urethral stone weighed 140 grams (8 by 5 cm.) and was located in the anterior urethra. An amazing feature of this case is that the patient was aware of the stone's presence for seven years and simply ignored it until an injury caused perineal pain. The second case was that of a "giant" stone in in the posterior urethra which measured 3 by 5 cm. (weight in grams not given). There are four roentgenograms, one photograph and four diagrams illustrating the location and the method of treatment used in the 2 cases reported.—*R. F. Niehaus, M.D.*

Carp, I. J., and Jacobson, M. B. Primary carcinoma of the ureter; a review and a report of two cases. *Urol. & Cutan. Rev.*, Jan., 1950, *54*, 39–45.

The authors report 2 cases with remarkably similar symptoms and urographic findings and with tumors in exactly the same location. Each patient presented himself with the complaint of hematuria and one had alteration of his urinary habits. In each instance cystoscopy was not diagnostic although blood was seen to come from the right ureter in one case and the ureter in the other case pouted slightly. On retrograde pyelography a completely blocked ureter was noted in each instance on the right side. Surgical removal of the kidney and entire ureter was followed in one case by a recurrence in six months and the patient died of a saddle thrombosis of the inferior vena cava; in the other case the patient died approximately one year after operation with recurrence in the bladder and bone metastases.

Primary carcinoma of the ureter occurs twice as frequently on the right side as on the left side. Likewise it is more frequent in men than

in women and is encountered in the usual carcinomatous age. The area or site of involvement increases in frequency as one moves from the kidney to the bladder. The tumors are either papillary or non-papillary and the latter type is the less likely to metastasize. Hematuria was noted in about 70 per cent of the reported cases, with pain coming next. The pain may be either the type associated with ureteral obstructions or that associated with metastases to bone structures. Apparently the cases which have the best prognosis are those in which no tumor mass is found on pyhsical examination indicating the localized nature of the lesion.

The treatment is surgical, consisting of total ureteral nephrectomy. If there has been no recurrence within four years, a cure may be assumed. Deep roentgen therapy has not been effective in the reported cases.—*A. J. Present, M.D.*

Abrahamsen, Harold. Ureterovesicostomy as a treatment of congenital stenosis of the lower part of the ureter. *Acta chir. Scandinav.*, 1949, *98*, 157–169.

Much has been written about obstruction occurring at the ureteropelvic junction, while relatively little attention has been paid to anomalies of the lower part of the ureter. Stenosis of the ureter in this area may be due to adnexal infection, carcinoma of the uterus or cervix, operative trauma, or congenital abnormalities.

The author has concerned himself with this latter group which he feels to be more frequent than ureteropelvic junction abnormalities, although not as frequently diagnosed. Congenital stenosis of the lower ureter occurs most often just above the ureteral opening of the bladder, or in the wall of the latter. In 7 out of 12 cases observed by the author over a ten year period, a cord, most likely representing a vestigial umbilical artery, was found to have directly compressed the ureter. In the remainder of the cases, the ureter was found to be imbedded in dense fibrous tissue at the point of stenosis.

Demonstration of the point of stenosis may be accomplished occasionally by intravenous urography, but can always be demonstrated on retrograde study. This is of primary importance to avoid confusion with "congenital megaloureter" if there be such an entity. Early diagnosis and corrective surgery will, of course, prevent progressive parenchymal destruction of the kidney.

The author performs a ureterovesicostomy as a corrective measure, with generally excellent results. In most cases some dilatation of the ureter or pelvis persists, although no evidence of obstruction remains. In 3 instances the operation was performed on patients having only one kidney.—*E. C. Lasser, M.D.*

Abeshouse, B. E., Goldstein, A. E., and Tankin, L. H. Ectopic ureteral orifice; report of four cases. *Urol. & Cutan. Rev.*, Jan., 1950, *54*, 7–17.

This congenital anomaly infers the abnormal opening of one or more ureteral orifices at some point other than the usual superior-lateral angle of the trigone.

In the past twenty-five years, the authors have encountered 6 cases of ureteral ectopia in 7,500 admissions on the urologic service of the Sinai Hospital, viz.: 1 case of ectopic opening in the vagina; 1 case of ectopic opening in the uterus; 2 cases of ectopic opening in the posterior urethra (males); 1 case of ectopic opening lateral to the urethral meatus on the right; and 1 case of ectopic openings, bilateral and intravesical, with malformation of the trigone.

Pathology. Pathological changes within the ectopic ureter are found in practically every case. The urinary tract above the ectopic orifice is usually dilated and is attributed to faulty neuromuscular development. The muscular walls are thin and may show inflamamtion, cellular infiltration and sclerosis. Strictures and valvular formations may be seen, and calculi obstructing the anomalous ureter have been reported. Urinary infection is said to be associated with the condition in 90 per cent of cases.

Symptomatology. When the ectopic opening is situated in the vestibule of the vagina, in the vagina proper, around the margins of the urethra or in the urethra proximal to the external sphincter, a characteristic history of constant dribbling or incontinence from birth is elicited. The dribbling usually occurs during the day and night and is independent of normal voiding.

Occasionally, when the ureter is in close approximation to the sphincter or if there is an associated stricture producing a dilatation and reservoir, urine may only escape upon straining or coughing.

Other urinary symptoms, i.e., urgency, dysuria, frequency, etc., are absent unless infection or other complications occur within

the other portions of the urinary tract uninvolved by the anomaly. Irritation of the skin about the vagina, vulva and thigh may be present due to constant soiling and irritation from napkins.

In the male, symptoms may be absent, ill defined or confusing. Pain, fever, and chills may be present if infection has supervened in the anomalous ureter and kidney.

Diagnosis. A careful and complete history and thorough physical examination is of great value in the diagnosis of ectopic ureter and its orifice. Next in importance are excretory urography, cystourethroscopic examination, retrograde pyelography, renal functional tests and urine examination. Early diagnosis in the first decade of life may spare these unfortunate persons years of misery.

The secretory function of the renal element of an ectopic ureter is usually poor or seriously impaired. Consequently, the urinary flow is low or intermittent and injected dye may not be secreted. The insertion of a catheter into the ectopic ureter with subsequent appropriate roentgenographic studies readily establishes the diagnosis.

Cystoscopy with catherization of the ureters may be some value although normal bladder and ureters are frequent findings. Careful inspection of the posterior urethra should be done in each case. A plain film (K.U.B) often fails to delineate the true outline of an affected kidney which may be situated rather high. However, a diagnosis of fused supernumerary kidney associated with an ectopic ureter may often be made in the absence of dye in the upper segment by noting the presence of a notch or ridging in the outline of the kidney indicating the demarcation between upper and lower segments. In pyelograms, particular emphasis should be placed on the downward displacement or the incomplete development of the upper major calyx of the lower segment caused by the pathologically impaired or diseased upper rudimentary segment. Intravenous urography, which is usually extremely useful in the diagnosis of the more common renal and ureteral anomalies is often of little value in cases of ectopic ureter. This is due to the fact that the affected kidney usually exhibits serious diminution of function and the excretion of the dye is so slow or inadequate in amount and consequently the outline of the kidney or ureter is not visualized.

Treatment. Each case of ureteral ectopia presents an individual surgical problem. The following operations have been employed with varying degrees of success: (1) ligation of ectopic ureter; (2) transplantation of ectopic ureter into the bladder (ureteroneocystostomy) or bowel (ureterosigmoidostomy); (3) resection of the affected portion of a congenitally normal kidney (bifid pelvis) and its ectopic ureter, i.e., partial nephrectomy; (4) heminephrectomy and uretectomy in case of ectopic ureter involving one-half of double kidney or horse-shoe kidney; (5) nephrectomy or nephroureterectomy if both segments of double kidney are diseased and opposite kidney is healthy; (6) anastomosis between ectopic ureter and its accompanying mate (ureteroureterosystomy) or between ectopic ureter and pelvis of lower half of double kidney (ureteropyelostomy) in cases of complete duplication of the ureter.

Four case records are given in detail.—*R. F. Niehaus, M.D.*

Wells, Charles. Studies in chronic retention. *Proc. Roy. Soc. Med.*, Jan., 1950, *43*, 43–52.

Renal function in prostatism and other obstructive states was studied in considerable detail over a period of a year, certain of the cases having been followed for a longer period. Cases of complete obstruction have been operated upon with immediate prostatectomy without preliminary catheterization. Intravenous pyelography has preceded surgery in all cases. It is surprising that with even the highest degrees of chronic retention the author has found a number of cases with completely intact upper urinary tracts. Patients who suffer no renal damage due to back pressure should do well whatever the basis of their operative treatment, and to subject such patients to a tedious two-stage procedure because the bladder is dilated is unjustified and a waste of time. In no case has the author had renal bleeding following immediate removal of complete obstruction. Patients who have been previously catheterized have given more trouble than those who have not been catheterized or cystoscoped.

The article contains ten roentgenograms of intravenous pyelograms and three tables of charts of blood chemistry, blood pressure and fluid balance.—*F. B. Markunas, M.D.*

Howard, H. H., and Holtham, W. H. Epidermoid carcinoma of the penis; statistical

study of 106 cases. *Urol. & Cutan. Rev.*, Jan., 1950, *54*, 45–49.

This report of 106 cases shows the distribution in cancer of the penis which roughly corresponds to the distribution of most malignancies; the average age in the group was fifty-nine years. Of the group 78 were married and 28 single; 102 were white and 4 colored. There were no racial characteristics except that there were no Jewish or Oriental patients in the group, indicating the importance of circumcision in early infancy. This is entirely consistent with the finding among Mohammedans in India who are relatively free of the disease, while it is quite frequent among the Hindus. No occupational relationship was noted. The duration of symptoms was less than one year in the majority of cases.

There seemed to be no correlation between trauma or venereal diseases as causative agents.

In 57 cases there had been no spread beyond the prepuce or glans; in 27 cases the corpus was also involved, and 21 cases showed metastases beyond the penis. Only 2 cases had been circumcised; phimosis therefore is undoubtedly an important predisposing factor.

Ninety-three of the 106 cases were operated on; 45 had amputation only, 48 had amputation with groin dissection, and of these latter 21 also had emasculation.

Of the complications 14 showed local sepsis and 8 groin sepsis. Four cases showed both local and groin sepsis and there was skin necrosis in 11 cases. Of the 13 cases who had preoperative roentgen therapy 5 with amputation only healed well, while 7 with emasculation plus groin dissection all developed skin necrosis. In 1 case in which groin dissection was done before roentgen therapy and emasculation, healing was well accomplished. It is of interest to note that in the cases with extensive surgery who did not have roentgen treatment, 4 developed some necrosis, 4 slight sepsis, and 6 healed well. It is also of interest to note that in the 48 cases in which a groin dissection was done the pathological report on the lymph nodes was negative for carcinoma in 40. Of the 8 who showed metastases in the lymph nodes, 1 died from extension to the abdomen four years later, 1 case could not be traced, and the others died of unrelated causes.

It is the feeling of the authors that preoperative and postoperative irradiation has been of practically no value. Moreover, it has delayed healing, has caused skin necrosis and has not prevented recurrence of the growth. Small lesions, however, have been successfully taken care of with adequate local application of radium. It would seem, therefore, that a radical dissection with or without emasculation is the only method of treatment by which a cure may be hoped for. In these instances no psychoses were encountered following complete emasculation.—*A. J. Present, M.D.*

NERVOUS SYSTEM

Elvidge, Arthur R., and Baldwin, Maitland. Clinical analysis of eighty-eight cases of metastatic carcinoma involving the central nervous system, with an outline of therapeutic principles. *J. Neurosurg.*, Nov., 1949, *6*, 495–502.

The authors present a clinical analysis of 88 neurosurgical cases of metastatic tumor involving the central nervous system. The primary and secondary sites of growth are compared with reference to the relative frequency of the anatomical location. The pathological types are noted, and the general methods of treatment are outlined.

In the cases of carcinoma of the lung or bronchus and breast, there was no apparent correlation in the side of the primary focus to the side of metastasis. Thus, it cannot be stated that a tumor arising in one or the other lung field would metastasize to one or the other cerebral hemisphere. However, the predominance of metastatic spread from the lung field was to the cerebral hemisphere as opposed to the cerebellum or spine. Primary carcinoma arising from the thyroid, bladder, prostate, cervix, ovary, adrenal gland, kidney and pancreas metastasized to the spinal column.

Metastatic carcinoma as a therapeutic problem in neurological surgery presents the necessity of the alleviation of increased intracranial pressure, the relief of pain and the prevention of paraplegia. In cases where the intracranial metastasis is single, removal should be considered for the relief of the intense headache apart from any improvement of neurological signs. The authors have found it desirable and wish to point out the value of simultaneous extradural section of spinal roots which are, and which are apt to be, compressed in cases justifying a decompressive laminectomy for impending paraplegia with partial removal of neoplasm. This procedure generally obviates

the necessity for cordotomy. In the special instance of diffuse pain of the upper extremity that does not respond to roentgen therapy, a posterior root section combined with cervical cordotomy has given satisfactory relief. It seems desirable to relieve spinal compression by decompressive laminectomy to prevent or minimize paralysis.—*K. K. Latteier, M.D.*

Albertengo, Juan B. Compresión medular por enfermedad de Hodgkin. (Medullary compression by Hodgkin's disease.) *An. de cir.*, Sept.-Dec., 1949, *14*, 172–185.

It is known that constriction of the lumen of the spinal canal can result from causes which are extradural or intradural, the latter being divided into intramedullary and extramedullary.

The author recites 3 cases of medullary compression in Hodgkin's disease, which rarely presents the classic symptomatology. These cases emphasize the frequency of extraganglionic localization. Confronted with the syndrome of radiculomedullary compression whose cause is surely extradural but whose etiology it has not been possible to determine, one should always suspect a malignant lymphogranuloma, even though the patient presents no other signs which have been described as classic for this disease. If, on the other hand, the clinical examination permits diagnostic certainty which has been confirmed by biopsy of a gland and if the patient presents signs of localized medullary compression, the treatment with roentgen rays should proceed. In cases with symptoms demanding prompt release of the block of the spinal canal and if it does not seem possible to use roentgen therapy, surgical operation is indicated. In the light of their experience, roentgen therapy seems to be the most effective. The authors have also employed urethane and nitrogen mustard.—*James T. Case, M.D.*

Fullenlove, T. M. Venous intravasation during myelography. *Radiology*, Sept., 1949, *53*, 410–412.

The author reports an example of venous intravasation which occurred during pantopaque myelography. The injection was made between the fifth lumbar and first sacral vertebrae and initially there was observed to be a large filling defect at this level on the right side. Subsequently the opaque oil was seen to leave the spinal canal through the venous plexus in this area and within three minutes the greater part of it was gone. Fluoroscopy of the chest immediately and later films of the abdomen showed no evidence of the escaped oil. The patient suffered no ill effects. It is thought that the pantopaque escaped along the course of the lumbar puncture into the intervertebral veins which in turn drain into the lateral sacral and ascending lumbar veins and thence into the inferior vena cava.—*A. E. Childe, M.D.*

SKELETAL SYSTEM

Josephs, Sydney. Growth of the foetal biparietal diameter during the last four weeks of pregnancy. *Brit. M. J.*, Dec. 24, 1949, *2*, 1440–1443.

It has long been accepted that the fetal biparietal diameter increases by approximately 2.5 mm. a week during the last four weeks of pregnancy and the age of the fetus has been estimated on this supposition.

The author presents a series of 189 cases where the biparietal diameters were estimated roentgenologically in utero and subsequently measured with calipers shortly after birth. Eighty-four of these cases were measured seven days or less before delivery so that any growth that could have occurred between measurements was negligible. From this series it was apparent that no error occurred greater than 5 mm., and in 75 of the cases the error was less than 2.5 mm. The roentgen method on an average was 0.5 mm. greater than the postnatal measurement.

In a group of cases the biparietal diameter was measured at the clinically estimated thirty-sixth week of pregnancy and the examination repeated four weeks later. In this group no evidence of growth of the head could be determined between the thirty-sixth and fortieth weeks of pregnancy. Owing to scanty data, the growth curve between the thirtieth and thirty-sixth weeks of pregnancy has not accurately been assessed, but early determinations indicate that the biparietal diameter appears to grow at a rate of less than 2.5 mm. in a week. The author therefore asserts that there is no growth of the biparietal diameter of the head between the thirty-sixth and fortieth weeks of pregnancy. He indicates that in the absence of craniostenosis it seems illogical to suppose that one diameter of the fetal skull should remain stationary while the other increases.—*W. M. Roy, M.D.*

Merchán, M., Gimena, J., and Gálvez Armengaud, F. Displasia metafisaria múltiple. (Multiple metaphyseal dysplasia.) *Bol. Inst. Pat. Méd.*, Dec., 1949, *4*, 230–235.

The authors propose the term "multiple metaphyseal dysplasia" for the designation of those multiple or generalized lesions of the skeleton which have their origin in the faulty development of the metaphysis and more specifically of the epiphyseal cartilage. The two principal pathologic conditions concerned are multiple exostosis and Ollier's disease. The first is also known under the names of diaphyseal aclasia (Keith), metaphyseal aclasia (Creig) and hereditary deforming dyschondroplasia, whereas the latter is often called multiple chondromatosis. Although both entities are easily identified clinically and roentgenologically, they are characterized by the same error of development, displaced nests of embryonal cartilage undergoing calcification and thus normal ossification. For this reason, they may be considered as variants of the same type of anomaly and dealt with under one heading. This viewpoint is also supported by the fact that a combination of the two lesions is occasionally found in the same individual.

Such a case came under the authors' observation recently. The case was that of a boy seventeen years of age who presented himself for examination because of a number of slowly growing tumors scattered throughout the body. The first lesion was noted at the age of two years on the right arm and was followed soon by another tumor of the thoracic wall. Since then similar tumors have appeared on the right lower femur, dorsum of both hands, etc. In the later stages of the disease a difficulty of walking developed, but without pain.

Roentgen examination revealed slight scoliosis of the lumbar spine to the left due to a fibrocystic involvement and deformity of several vertebrae, chiefly of L_1. The adjacent intervertebral discs were narrowed. The pelvis was asymmetrical and considerably deformed, the bones being involved in a process similar to that seen in the vertebrae. There was an enormous deformity of the pubic rami and a bulbous enlargement of the necks of both femora. The right femur assumed a dumbbell-shaped appearance. At the lower end of the right femur there was a large cauliflower-like exostosis. The right tibia and fibula and the upper third of the right humerus also showed several exostoses, some of which were quite large. They were all located in the metaphyseal portions of the bones. Less conspicuous lesions were present in some of the other bones.

A lesion of the hand was removed for biopsy and the microscopic report was that of osteochondroma.

In short, the case represents a combination of multiple exostosis and Ollier's disease.

Since there is a hereditary and familial tendency in multiple exostosis but not in Ollier's disease, it must be admitted that from the pathogenic standpoint the two processes represent distinct entities.

The treatment of multiple metaphyseal dysplasia is nil. The larger lesions may be excised for mechanical reasons and to relieve the pain, if this becomes too severe.—*T. Leucutia, M.D.*

Evans, F. Gaynor, Alfaro, Abel, and Alfaro, Samuel. An unusual anomaly of the superior extremities in a Tarascan Indian girl. *Anat. Rec.*, Jan., 1950, *106*, 37–47.

A case of congenital bilateral partial absence of the radius, with associated hand deformity, in an eleven year old Tarascan Indian girl from Mexico is described. The great majority of previously reported cases of congenital radial defects were found in individuals of European stock.

Congenital absence of the radius is more frequent in males than in females, and complete absence is more common than partial absence.

The carpal and other hand bones most frequently absent in cases of congenital radial defects are the greater multangular, the navicular, the first metacarpal, and the phalanges of the thumb.

Bilateral partial absence of the radius occurs in 3.1 per cent of the reported cases of congenital radial defects.

Congenital radial defects are frequently associated with other anomalies so severe that the individual does not survive long, 60 per cent of the reported cases occurring in fetuses, newborn, or infants less than one year of age.

Many congenital radial defects are hereditary.—*Russell Wigh, M. D.*

Ragan, Charles. The general management of rheumatoid arthritis. *J.A.M.A.*, Sept. 10, 1949, *141*, 124–127.

The author bases his report on a total of 374 patients followed in the Edward Daniels Faulkner Arthritis Clinic, of the Presbyterian Hospital, and Department of Medicine, College of Physicians and Surgeons, Columbia University. All of these were followed for more than five years, the average observation being eleven years and the longest follow-up period, twenty years. No cases of rheumatoid arthritis of the spine (Marie-Strümpell) were included since the author regards it as a different disease from rheumatoid arthritis of the peripheral joints. His contention is justified by analysis of distribution of involvement in spine and joints in the two groups and also by the results of positive agglutination of Group A, hemolytic streptococci. At the end of the period of observation, 10 per cent of patients were confined to bed or chair, 28 per cent had flexion contractures with active arthritis, 12 per cent had flexion contractures with inactive arthritis, 26 per cent had no evidence of arthritis, and 22 per cent had minimal complaints, chiefly occasional joint pains. As an indication for prognosis, he utilized Group A, hemolytic streptococcus, agglutination in the serum of patients, and found that where the test was positive, the prognosis was generally poor. While this is not absolute, since some patients with positive agglutination do well, and some with negative agglutination end badly, it is believed that the presence of severe typical rheumatoid arthritis or a positive streptococcus agglutination warrants heroic measures.

This has practical significance since a therapeutic measure which might have dangerous potentialities or which might interfere with the life situation would be justified if the ultimate outcome were improved. Among the potentially harmful agents he includes gold compounds, multiple transfusions, radiotherapy, and fever therapy. Treatment is considered under the headings of rest and exercise, prevention of deformities, salicylate and other therapy, physical therapy, effect of climate, multiple blood transfusions, radiotherapy, and fever therapy. In direct contradistinction to its effects in the Marie-Strümpell type of spondylitis, radiotherapy has been disappointing in rheumatoid arthritis and, in the author's experience, the results have been so variable as to contraindicate exposure of the patient to a possibly harmful agent.

The aim of the physician in treatment of patients with rheumatoid arthritis should be to allay pain and to prevent flexion contractures or deformities as far as possible. The patient should be encouraged to keep an optimistic attitude. If deformities have ensued, a program of re-education for economic and social self-sufficiency is extremely important.—*A. K. Wilson, M.D.*

Ellman, Philip. Morquio-Brailsford's disease simulating the arthritic manifestation of rheumatoid disease. *Ann. Rheumat. Dis.*, Dec., 1949, *8*, 267–276.

Two case histories and roentgenograms are presented. The cases are good examples of the condition originally described by Morquio and Brailsford. The spines and hip joints are chiefly involved, but attention is called to the changes in the phalanges of the hands. Clinically, the appearance of the hands is not unlike changes seen in rheumatoid arthritis. The differential diagnosis is by roentgen examination. The joint swellings in this disease are entirely articular rather than periarticular as in rheumatoid disease.—*R. E. Kinzer, M.D.*

Desmarais, M. H. L. The neutral 17-ketosteroids in rheumatoid arthritis and spondylitis. *Ann. Rheumat. Dis.*, Dec., 1949, *8*, 296–298.

Davison and others reported (1947) an increased urinary excretion of 17-ketosteroids in 13 male cases of ankylosing spondylitis. The author checked the urinary excretion of neutral 17-ketosteroids in 87 cases of rheumatic conditions. He concluded that the estimation of 17-ketosteroids in rheumatoid arthritis is of very little clinical value.—*R. E. Kinzer, M.D.*

Alyea, E. P., and Rundles, R. W. Bone marrow studies in carcinoma of the prostate. *J. Urol.*, Sept., 1949, *62*, 332–339.

Carcinoma of the prostate was formerly thought to metastasize mainly by way of the lymphatics but evidence is now accumulating to indicate that the hematogenous route is a very frequent if not the most common means of metastasis. This is indicated by the frequency of positive sternal bone marrow biopsies. One of the authors was able to demonstrate carcinoma of the prostate in 18 bone marrow biopsies, 15 in the sternum, in a group of 32 cases. In all positive cases tenderness was present over the sternum. The technique of sternal aspiration is given in some detail. Bone marrow

metastases were demonstrated in 14 of 24 cases with roentgenologic or biopsy proof of metastasis. Comparative studies showed that elevation of the serum acid phosphatase was a more accurate index of bone metastases than is the sternal marrow puncture.

The value of bone marrow biopsy study was established by a few cases in which questionable rectal and roentgen studies were confirmed by positive marrow studies. In addition the study has prognostic importance since the number of malignant cells in the marrow has been found to decrease with hormonal therapy and relief of anemia.—*R. M. Harvey, M.D.*

Maróttoli, Oscar R., and Didier, Arnoldo E. Homoinjerto de hueso conservado; el banco de hueso. (Homologous graft of preserved bone; bone bank.) *An. de cir.*, Sept.-Dec., 1949, *14*, 162–171.

The authors based their work on the experience of Philip Wilson in the Hospital for Special Surgery of New York and Alan de Forest Smith and collaborators in the New York Orthopedic Hospital. The authors' experience up to the present includes 36 observations on 30 patients in which they have employed bone taken from 46 different donors. The material grafted and kept in the bone bank included ribs obtained during thoracotomy, spongy bone from the ilium during operations on the hip joint; also material from osteotomies done in the ankle, rib resection, metatarsal extirpation and bone after amputations through the middle third of the thigh. The bone employed has been preserved from twenty-four hours to fifty-four days. With one single exception the postoperative experience was excellent in all, with healing by primary intention and without any findings of intolerance of the grafted bony material. The exception was a case following acute puerperal vertebral osteomyelitis. In spite of the loss of many of the small bone grafts some of them took and the final result was good fusion without any mobility.—*James T. Case, M.D.*

Marcozzi, Giovanni. Sui segni radiografici iniziali della coxite nell'infanzia (un segno radiografico poco noto per la diagnosi precoce). (Initial roentgenographic signs of coxitis in children [a little known sign for early diagnosis].) *Ann. radiol. diag.*, Jan.–Feb., 1950, *22*, 3–26.

Tuberculous coxitis (arthritis of hip joint) in children occurs usually between the ages of two and twelve, and is the most common form of arthritis next to tuberculous spondylitis. The use of modern clinical and diagnostic methods has enabled earlier diagnosis and treatment.

The early diagnosis of tuberculous coxitis relies primarily on roentgenographic signs which appear first and at times are difficult to interpret specifically.

Two hundred case records of arthritis in children treated at the Tuscan Institute of Orthopedics from 1940 to 1945 were reviewed. Twenty-five of these cases were analyzed in detail with particular emphasis on early roentgenographic findings which are enumerated and evaluated in this article. Many of these findings are well illustrated in the article.

1. Demineralization of head and neck of the femur on the affected side is the only constant finding. It is due to disuse or immobilization of the part and usually appears early, especially when tuberculosis originates in the synovia.

2. Circumscribed bone osteolysis may occur either in the head or the neck of the femur and usually adjacent to the epiphyseal line. Its presence on the roentgenograms is inconstant; it may be single or multiple and occasionally it may contain calcium in various forms.

3. Alterations of articular margins of acetabulum or head may be demonstrated as simple blurring, irregularity in the bone density or actual deformity which suggests osteochondritis.

4. Alterations of joint space differ. In 10 cases there was fluid within the joint demonstrated by widening of the joint space, while in 15 cases the joint space was narrowed. The former is more likely to occur during the first six months of the disease, whereas the latter usually occurs after the first six months.

5. Alterations of soft tissues about the hip joint may also be observed. Often the capsule is seen to bulge as a uniform density with convex borders to the medial and lateral sides of the neck. The surrounding muscle outlines may be obliterated as the result of muscle atrophy and regional congestion.

6. Changes in the epiphysis for the head: the coexistence of increased bone growth on the same side with existing bone infection was described by Langenbeck in 1927, Ollier and Maffi in 1921; similarly in tuberculous arthritis

of the hip, enlargement of the femoral head was described by Delorme, Poli in 1931, and Lindemann in 1940. This enlargement is evidently a true bone hypertrophy rather than a projection illusion. In the author's series, generalized enlargement of the head occurred in 5 cases. In 17 cases, however, the head was flattened and elongated, especially at its medial aspect. This finding occurred early in the disease. It is suggestive of tuberculosis. It is possible that actual enlargement of the head precedes a true deformity.—*C. A. Priviteri, M.D.*

Sachs, M. D., McGaw, W. H., and Rizzo, R. P. Studies in the scope of pneumoarthrography of the knee as a diagnostic aid. *Radiology*, Jan., 1950, *54*, 10–32.

The authors discuss the use of oxygen in the knee joint as a contrast medium to enable visualization of structures not otherwise demonstrated in roentgenograms. The injection technique and roentgen technique are described.

The structures and findings to be demonstrated in both normal and pathological pneumoarthrograms are discussed. Excellent film reproductions and diagrammatic sketches are presented, illustrating fractures and dislocations of menisci, cyst of meniscus, synoviomas, Baker's cyst, tuberculous synovitis, chronic villous synovitis, Charcot knee, ruptured patellar tendon, and loose bodies in the joint. The authors point out that multiple views are necessary. They use six views in the posteroanterior position, three of these with the medial aspect of the joint spread open, and three views with the lateral aspect of the joint spread open. The three views include the straight posteroanterior, one with the foot in inversion, and one with the foot in eversion. In addition, a lateral and an anteroposterior view are made. The use of technical factors which produce maximum soft tissue and bone detail is stressed. It has been a completely safe procedure in over 1,000 cases.

A statistical evaluation of accuracy in diagnosis was made. In those cases with surgical follow-up, the pneumoarthrogram diagnoses alone were correct in 86.5 per cent, the clinical diagnoses in 71.1 per cent, and the combined clinical and roentgen diagnoses in 96 per cent.—*D. S. Kellogg, M.D.*

Krainin, Philip, D'Angio, Carl J., and Smelin, Ammiel. Multiple myeloma with new bone formation. *Arch. Int. Med.*, Dec., 1949, *84*, 976–982.

There is unanimity of opinion among authorities on the subject that the typical and characteristic lesion of bone in multiple myeloma is a discrete osteolytic involvement. The roentgenographic appearance is usually that of a punched-out area with sharp margination and without evidence of surrounding productive reaction. In a description of multiple myeloma Boyd stated, "It is a pure rarefying lesion with no formation of new bone." To quote Geschickter: "The widespread occurrence of small, sharply demarcated defects in the marrow cavity, unaccompanied by bending deformity or the formation of new bone, are the cardinal features in the diagnosis of multiple myeloma." Snapper affirmed that in multiple myeloma "no new formation of bone takes place." Shanks, Kerley and Twining declared categorically concerning the osseous lesions of multiple myeloma that "They are entirely osteolytic, and never give rise to new bone formation."

The case presented is of unusual interest because it has been possible to demonstrate conclusively by histologic and roentgenographic study the formation of new bone in a patient with proved multiple myeloma. A search of the literature of this disease has brought to light no other case in which a significant degree of new bone formation, aside from that occurring at the site of pathologic fracture, was visualized on histologic and roentgenographic examination.—*E. J. McDonald, M.D.*

Muri, J. Diabetic arthropathy and intercapillary glomerulosclerosis. *Acta med. Scandinav.*, Dec., 1949, *135*, 391–398.

A case is presented of a forty-three year old male who developed a Charcot ankle joint after an eighteen year history of poorly controlled diabetes mellitus. Roentgenographic examination revealed a complete destruction of the talus. Blood and spinal fluid Wassermann reactions were negative. Signs of a chronic nephritis and severe proliferative retinitis were present.

Postmortem examination showed moderate neuritic changes of the posterior tibial nerve, slight retrograde changes of the motor neurons of the spinal cord, and intercapillary glomerulosclerosis.—*Charles Nice, M.D.*

Noyez, D. Le syndrome de la dysplasie fibreuse. (The syndrome of fibrous dysplasia.) *Acta chir. belg.*, Jan., 1950, *49*, 101–113.

A case of spontaneous fracture of the left femur due to fibrous dysplasia induces the author to present a detailed study of Albright's syndrome.

Osteitis fibrosa cystica, localized or generalized, concomitant with a normally functioning parathyroid has been named variously as: fibrous osteodystrophy (non-generalized), juvenile Paget's disease, unilateral fibrous osteodystrophy and unilateral Recklinghausen's disease. However, Albright and Lichtenstein distinguish three forms of the syndrome according to the degree of the extension of the lesion, namely (1) the monostotic form, (2) the polyostotic form and (3) the most complete form characterized by Albright's triad: osseous lesions, café-au-lait pigmentation and true precocity. The osseous lesions are the most important. These tend to be unilateral and roentgenologically the findings are: (1) areas of irregular bone destruction with a tendency to formation of pseudo-cysts, (2) thinning of the cortex, (3) also, areas of increased osseous density with intermingled zones of normal bone and eventually (4) secondary deformations (as coxa vara). The laboratory findings are normal for calcium, phosphorus and cholesterol with generally an increased serum phosphatase.

Pathologically, there is a fibrous proliferation (with only a few osteoclasts). This fibrous tissue, which roentgenologically gives the pseudocystic images, harbors here and there osseous and cartilaginous tissue. This is considered by Albright as a very important diagnostic feature differentiating fibrous dysplasia from neurofibromatosis and Recklinghausen's disease. The pseudo-cystic formations in neurofibromatosis are the result of an external invasion of the bone. Moreover, neurofibromatosis never presents areas of bone destruction concomitant with osseous reaction. Albright's syndrome should be differentiated from (1) Recklinghausen's disease, (2) neurofibromatosis, (3) dyschondroplasia, (3) xanthomatosis and (5) Paget's disease.—*J. N. Sarian, M.D.*

Dos Santos, Reynaldo. Arteriography in bone tumours. *J. Bone & Joint Surg.*, Feb., 1950, *32B*, 17–29.

Simple arteriography, by the injection of opaque solutions into the proximal part of the main artery of a limb, gives a picture of the vascular pattern down to the smallest branches at any given moment a few seconds after beginning the injection; but if a series of films is taken at intervals of one, two and three seconds, information of a wider character is made available. Serial films, according to the author, show not only the anatomical distribution of blood vessels but also the functional state and activity of the peripheral circulation. The technique is of value in the diagnosis of tumors of soft tissues and bone, and particularly in the differential diagnosis of bone tumors from chronic osteomyelitis. It may be used to assess the response of malignant tumors to treatment by irradiation.

In malignant bone tumors, serial arteriograms show irregular formation of new vessels of uniform diameter, "blood pools," and increased rapidity of flow from arterial to the venous systems. In osteoclastomas there is new vessel formation and an appearance of "blood pools," but less rapid filling of the veins. In simple tumors there is no new formation of vessels. The tumor itself is often relatively avascular.

In osteomyelitis there is no new formation of vessels but only dilatation of existing vessels. The vessels retain their orderly arrangement of successive branches of gradually decreasing diameter.

Arteriography is of value in assessing the response of a tumor to irradiation. The initial arteriogram usually shows the limits of new vessel formation and the richness of the newly formed network and it may even show distortion of the main vessel by pressure of the tumor. After successful irradiation the arteriogram assumes a more normal appearance. The main vessels are restored to their usual positions and the newly formed vascular network may disappear entirely. These changes are an index of the vascular sclerosis which is one of the factors in determining the control or regression of the tumor. The authors consider the use of arteriography to assess the response to irradiation as one of its most interesting and useful applications.—*R. S. Bromer, M.D.*

Wildervanck, L. S. Hereditary congenital abnormalities of the elbows, knees and nails in five generations. *Acta radiol.*, Jan., 1950, *33*, 41–48.

The author studied a family of 53 members of which 22 showed abnormalities of the elbows,

knees and/or nails. The elbow anomalies included luxation of the radius, rounded capitellum, unusually conspicuous capitellum, insufficiently developed humeral capitellum and/or exostosis of the ulna.

The unusual findings about the knee joint included luxation of the patella and hypoplastic or absent patella. Some of the nails were absent or hypoplastic or they showed clefts or large triangular lunulae. In certain members of this family, the little fingers were crooked.

From this study the author concludes that the hereditary transmission of this complex of anomalies is not sex linked and that they are irregularly dominant. However, there was no generation in which none of the three anomalies occurred. He assumes that there are three incompletely linked genes for the elbows, knees and nails.—*Mary Frances Vastine, M.D.*

Abbott, O. D., Townsend, Ruth O., French, R. B., and Ahmann, C. F. Carpal and epiphysial development; another index of nutritional status of school children. *Am. J. Dis Child.*, Jan., 1950, *79*, 69–81.

Data on the appearance and development of carpal bones and epiphyses of the distal parts of the radius and ulna of 162 rural school children, six to thirteen years of age, are presented in this paper. The degree of skeletal development or bone age, of these children was determined by comparing the roentgenograms of each child with Todd's standard and descriptive guide for carpal development according to sex and age. The subjects were taken from cooperative families among the economically stable classes. They were free from gross mental or physical defects and had a favorable environment and an abundant and well balanced diet. Each child was under the active supervision of a physician, and any child who had a serious illness was excluded from the study.

The authors conclude that osseous development of the carpal bones and the epiphyses of the distal ends of the radius and ulna offers another valuable means of assessment of the nutritional status of school children. The great difference which they found between chronological and carpal age, as observed in many children, indicates that these children had had a major setback in ossification. Wide variations in carpal age were seen in children of the same sex and age. Data on this group of children show that malnutrition interrupts both the sequence and the time of carpal appearance. Successive roentgenograms of a greatly retarded boy are shown which illustrate the way in which carpal centers record the effects of malnutrition and, later, the effects of improved nutrition. In the paper, the relationship of consumption of milk to skeletal development is pointed out.—*R. S. Bromer, M.D.*

Stronge, R. Fawcett, and McDowell, H. B. A case of Engelmann's disease; progressive diaphyseal dysplasia. *J. Bone & Joint Surg.*, Feb., 1950, *32B*, 38–39.

Reports of 6 cases of Engelmann's disease were found in the literature. The case reported in this paper is the first record of a patient with the disease in the third decade. The authors note that no material change has occurred in the roentgenographic appearance of the patient during the three and a half years that he has been under observation. The roentgen changes were symmetrical thickening of the compact bones of the shafts, the bones were widened, the surfaces were slightly irregular and the medullary cavity was narrowed. A number of small cystic cavities were present in the compact bone. The ends of the bones appeared normal and the epiphyses were united. The radius and ulna and the tibia and fibula on both sides showed similar changes but appeared normal in their distal thirds. The skull showed coarse sclerotic patches in the base and vault, especially in the frontal and occipital regions but the parietal bones were relatively unaffected. The ribs were large, but their structure was unaltered. The facial bones, G clavicles and other bones of the skeleton appeared normal. Clinically the outstanding feature of the case was the gross muscular underdevelopment and weakness, which was similar in many respects to that of a primary muscular dystrophy.—*R. S. Bromer, M.D.*

Bingold, A. C. Engelmann's disease; osteopathia hyperostotica (sclerotisans) multiplex infantilis; progressive diaphysial dysplasia. *Brit. J. Surg.*, Jan., 1950, *37*, 266–274.

The 7 cases of this rare disorder which have been published (1929–1949) are reviewed and an eighth case is reported in detail. Englemann's disease, probably better known in the United States as "progressive diaphysial dysplasia," is characterized by underdevelopment, malnu-

trition, progressive hyperostosis and fusiform expansion of the cortex of the long bones.

Clinically, these patients have ranged in age from four to twenty-four years; 5 were males and 3 females. A poor appetite, easy fatigability, delayed development have been common symptoms. These patients have been frail and arms and legs were relatively elongated. A peculiar gait and delayed sexual characteristics were observed in several.

Bone biopsies showed an increase in compact bone of the shaft due to new apposition of bone by osteoblastic activity on both periosteal and endosteal surfaces. No evidence as to etiology can be had from the pathologic changes observed thus far.

The roentgenologic changes consist of symmetrical, dense expansion of the cortex of the diaphyses of the long bones, tending to obliterate the medullary cavity. The demarcation of normal from abnormal bone is abrupt. The lesions are progressive in the long axis of affected bones and have been observed in all the long bones of the body except hands, feet and ribs.

Other diseases which produce similar sclerosis must be considered in the differential diagnosis, namely: (1) osteopetrosis—density most marked in metaphyseal area, ends of bones may be expanded; (2) infantile cortical hyperostosis —irritability of patient, bones involved not symmetrical, mandibles and ribs often involved, soft tissue swelling over affected bones, return to normal appearance in two to three years; (3) metaphyseal dysplasia—marked osteoporosis at ends of involved bones with sclerotic areas in mid-shaft, symmetrical involvement. Other conditions to be kept in mind for differential diagnosis are: congenital syphilis, yaws, leukemia, industrial fluorosis, and hypervitaminosis A.—*George P. Keefer, M.D.*

Cocchi, Umberto. Polytope erbliche enchondrale Dysostosen. (Polytopic hereditary enchondral dysostoses.) *Fortschr. a. d. Geb. d. Röntgenstrahlen ver. m. Röntgenpraxis*, Feb., 1950, *72*, 409–435.

Polytopic hereditary enchondral dysostoses is the collective name for a group of diseases which are marked by numerous strongly symmetrical disturbances of the skeletal cartilage, particularly of the epiphyses. These dysostoses can be divided into three groups: polytopic enchondral dysostosis with dominant heredity without clouding of the cornea (type Léri); polytopic enchondral dysostosis with recessive heredity without clouding of the cornea (type Morquio); and one with clouding of the cornea (type Pfaundler-Hurler).

Shortness and dwarfism, disturbances of mobility, deformity of the thorax and the ends of the extremities occur frequently and are often severe. The disease occurs in families with varying degrees of deformity among siblings of one family.

Physiognomic changes (gargoyle mask), severe deterioration of intelligence, hydrocephalus, difficulty in hearing and deafness, enlargement of liver and spleen, in addition to the clouding of the cornea, are common in the Pfaundler-Hurler type.

A correct diagnosis is possible only after an extensive study of the family and exact roentgenological and clinical observation, with particular reference to the eyes.

The roentgen findings are not characteristic for any one particular group. Involvement of the spine with kyphosis due to marked deformity of the vertebral bodies and deformities of the epiphyses of the long bones are the most common roentgenological manifestations.—*H. P. Mueller, M.D.*

Hernberg, C. A., and Edgren, Walter. Looser-Milkman's syndrome with neurofibromatosis Recklinghausen and general decalcification of the skeleton. *Acta med. Scandinav.*, 1949, *136*, 26–33.

Insidious spontaneous fractures were observed as early by von Recklinghausen, but not until 1920 were they studied more closely by Looser in his investigations of late rickets and osteomalacia. He found that in these diseases changes sometimes occurred which on superficial examination seemed to be fractures but in reality were decalcified, so-called transformation zones (Umbauzonen) in the bone structure and were revealed by roentgenography as transparent bands.

Milkman, in 1934, described a condition with multiple, double-sided Looser's zones approximately symmetrically distributed as a specific, idiopathic disease. The onset of the disease is insidious and it develops in periods of varying activity. The first symptom is usually low back pain, causing the patient to waddle. Later, pain and tenderness to pressure appear also in other parts of the skeleton. Classical symptoms are absent. In advanced cases the body length

may be considerably reduced owing to skeletal deformities.

On roentgenograms the bones seem to be crossed by clear bands from 1 mm. to 1 cm. wide, as if there the bone structure had been removed. Otherwise the bone has a fairly normal appearance.

At the beginning of the process the cortex shows a small, round or irregularly punctated, decalcified area which gradually spreads and encircles the bone. The periosteum is uninjured and the outline of the bone at first remains unbroken. Only at an advanced stage and in places where the strain has been great do dislocations and deformities appear.

Signs of spontaneous regression are few, and are indicated in the roentgenogram by two denser bands, one on each side of the transparent zone.

Histopathologically the bone within the zone is transformed from the original lamellar into trabecular bone or it consists of uncalcified osteoid tissue.

About 60 cases of insidious, symmetrical pseudofractures have been published. In a critical study of the literature, Herold has classified them as follows: (1) cases with unfavorable prognosis; "Milkman's disease," renal osteopathy, cystine disease; (2) cases with favorable prognosis; hunger osteomalacia, convent osteomalacia; and (3) cases with uncertain prognosis; certain cases of Basedow osteomalacia, osteomalacia in hypophyseal, parathyroidal or ovarian dysfunction.

The prognosis is dependent on the possibility of treating the underlying disease. The existence of a specific, idiopathic "Milkman's disease" is doubted by most authors. They consider the condition a syndrome, which may appear in connection with several different skeletal diseases, but especially in osteomalacia. Milkman's own case was, as noted by Herold and others, not sufficiently studied in that respect.

The blood chemistry in Milkman's syndrome is governed by the underlying disease. A low phosphorus value combined with a high phosphatase value of the blood often indicates osteomalacia.

The disease affects women mostly. Some cases have been examined postmortem but no other etiology has been discovered than the fundamental diseases mentioned above.

A case of neurofibromatosis is presented which had Looser zones in the right femoral neck, iliac bones, metatarsals, cervical and lumbar vertebrae, ribs, scapulae, metacarpals, skull and right fibula. Bone cortex was very thin. Serum calcium was 9.18 to 11.2 mg. per cent. Serum phosphorus 2.3 mg. per cent, serum phosphatase 3 BE; serum protein 6.7 per cent, Albumin 3.9 per cent, globulin 2.8 per cent. The mean output of calcium in the urine during four days was 69.2 mg. per day, or slightly less than in a normal control. Thus, apart from the fairly low phosphorous value, the blood chemistry did not differ very much from the normal, and did not definitely support the assumption of osteomalacia. A certain reservation is indicated as regards the phosphatase value which is not always reliable.

Considerable recalcification followed after the patient was given high doses of vitamin D. —*Charles Nice, M.D.*

Martens, Erich. Differentialdiagnostische Schwierigkeiten bei der kindlichen Kniegelenkstuberkulose. (The difficulties of the differential diagnosis in tuberculosis of the knee joint in children.) *Schweiz. Ztschr. f. Tuberk.*, 1950, *7*, 129–145.

The differential diagnosis is illustrated by 11 case histories given in detail, some of them accompanied by reproductions of roentgenograms. All the cases with the exception of 2 were sent to the hospital with the diagnosis of tuberculosis of the knee joint.

They include cases of luetic gonitis, osteomyelitis of the lower end of the femur, tuberculosis of the tibia, Brodie's abscess of the femur, gonitis after scarlet fever, hemarthrosis in hemophilia, sarcoma of the femur and nonspecific inflammations of the joint.

The importance of the roentgenographic examination with control films of the unaffected joint is stressed. In tuberculosis of the joint, the first roentgen sign appearing about three months after the onset of the symptoms is a pronounced, diffuse, homogeneous osteoporosis of the bones adjacent to the joint. A more irregular, patchy or streaky decalcification is unusual for tuberculosis and as a rule indicates a different etiology.

Later, the typical knee changes appear, but even then the diagnosis should not depend on the roentgen findings alone, as the cases mentioned above presented similar roentgen findings.

The history, blood count, sedimentation rate, Wassermann reaction, intracutaneous tuber-

culin test (Mantoux-Mendel), bacteriological examination of pus and aspired exudate help to establish the diagnosis.—*Karol E. Matzinger, M.D.*

Kneidel, J. H., Smith, L. A., and Bishop, R. E. Unilateral tuberculous abscess of the thoracic spine with roentgen findings of a dumb-bell neurofibroma. *Radiology*, Jan., 1950, *54*, 78–81.

The authors present a patient with tuberculous abscess of the thoracic spine, presenting unilaterally, and showing many of the criteria usually described for the diagnosis of dumb-bell neurofibroma. The patient, a twenty-one year old colored female with a flaccid paraplegia two weeks in duration, had a small residual chest sinus at the site of an abscess opened a few months earlier.

Films of the chest and thoracic spine showed a sharply outlined right paravertebral soft tissue mass at the level of the fifth and sixth thoracic vertebrae, with widening of the intercostal space between the fifth and sixth right ribs, erosion of the adajcent rib margins, and destruction of part of the head of the fifth rib and of the adjacent right transverse process. No destruction of vertebral bodies was seen. The intervertebral disc spaces were well preserved. The left posteromesial pleural line was not displaced. Myelography showed almost complete block at the level of the fifth thoracic interspace, with deviation of the opaque column to the right as if by an extradural mass.

On the basis of a preoperative diagnosis of dumb-bell spinal neurofibroma, the thoracic spine was surgically explored, revealing caseous material at the level of the fifth and sixth spinous processes, and a large extrapleural tuberculous cavity anterior and lateral to the fifth and sixth bodies. Laminectomy showed granulation tissue over the anterior and posterior surfaces of the dura. The patient improved temporarily after surgery, but then showed a retrogressive course with death on the twenty-third postoperative day, presumably from tuberculous meningitis.—*H. P. Brean, M.D.*

Guerreiro, Geraldo. Lateral roentgenographic examination of the thoracic spine. *J. Bone & Joint Surg.*, Jan., 1950, *32A*, 192.

This short article is a description of a technique for exposure of the thoracic spine which apparently has been previously described. The author's procedure consists of placing the patient in an upright position with vertebral support. The patient is told to breathe slowly and deeply during the course of the roentgenographic exposure. As a result of this technique, there was a complete disappearance of the ribs on the film. The spinal column was outlined with clarity and the aortic arch was also clearly outlined.—*R. S. Bromer, M.D.*

Arkin, Alvin M. The mechanism of rotation in combination with lateral deviation in the normal spine. *J. Bone & Joint Surg.*, Jan., 1950, *32A*, 180–188.

The purpose of this paper is to investigate the combination of rotation with lateral deviation in the normal spine, to describe the underlying causes for such rotation and to discuss some concepts currently accepted. Fifty-four roentgenograms in the anteroposterior position were taken in 8 living subjects. The roentgenograms of 3 of these subjects were discarded because of slight curvatures, either alone or in combination with fixed rotation. Thirty-nine anteroposterior roentgenograms were taken of the remaining 5 subjects, aged twenty-seven, twenty-six, fifteen, eleven and ten years. All had straight spines without curvature or rotation. Roentgenograms were taken in active and passive lateral deviation in (*a*) hyperextension, (*b*) flexion, and (*c*) neutral position. Some were taken with the subjects sitting, standing, or recumbent and with the hips flexed or extended. Flexion and extension were maintained by applying air pillows under the small of the back or under the pelvis and shoulders with the patient supine.

The author concludes that the intrinsic mechanism for rotation in combination with lateral deviation in the normal spine depends upon soft tissue tensions rather than upon the arrangement of the spinal articular facets. He summarizes the behavior by stating that the structure under the greater tension will describe the straighter line. Thirty-nine roentgenograms showed in 5 subjects a tendency to convex-side rotation in both flexion and extension of the laterally deviated spine.—*R. S. Bromer, M.D.*

BLOOD AND LYMPH SYSTEM

Carroll, David S., and Evans, John W. Roentgen findings in sickle-cell anemia. *Radiology*, Dec., 1949, *53*, 834–845.

Sickle-cell anemia is most common blood dyscrasia in Negroes. The authors describe

pathological changes which occur in blood, spleen and liver. The disease produces blood stasis with congestion and thrombosis, symptoms of bone and joint pain, fever and leukocytosis. The differential diagnosis is discussed.

Roentgen findings were absent in 17 of 37 cases. The bones of extremities show widening of medullary cavity, thinning of the cortex, increase in calcium content and prominent trabeculation. Periosteal elevation is rare. There is occasional sclerosis and cortical thickening at expense of the medullary cavity.

The skull shows osteoporosis with accentuation and widening of the diploic spaces and often thickening of the calvarium. Perpendicular striations, contrary to popular belief, are not common.

The spine and pelvis may show osteoporosis and accentuation of the trabecular markings. There may be decrease in height with biconcave deformity of the vertebrae.

Cardiac enlargement is one of the most constant observations. Occasionally associated pulmonary congestion is present.

Eighteen figures are used for illustration.—*E. E. Seedorf, M.D.*

Stout, Arthur Purdy. Hemangiopericytoma; study of twenty-five new cases. *Cancer*, Nov., 1949, *2*, 1027–1054.

Twenty-five cases of a rare vascular tumor, originally called "hemangiopericytoma" by Stout and Murray, are reported in order to display its histopathological and clinical features and to attempt to establish whether or not it is a definite entity. It is the opinion of the author that the tumors are derivatives of the cells with long branching processes applied to outer walls of capillaries and named "pericytes" by the Swiss histologist, Zimmerman.

The tumors showed no sex predilection. The ages at reported onset varied from birth to eighty-one years. The anatomical distribution was wide and the tumors apparently occurred wherever capillaries are found. The majority, however, occurred in the superficial soft tissues chiefly in the subcutaneous and muscular layers.

The tumors varied greatly in size. Many of them were small but 11 exceeded 3 cm. in diameter. The tumors were usually firm, apparently circumscribed, and often nodular. Calcification in the tumor mass was noted in 3 cases but actual necrosis of the tumor tissue is apparently rare.

The rate of growth was varied. One tumor was known to have been present for at least sixty years. On the other hand, the known duration of the majority was usually measured in months and was seldom more than three years. There was definite proof of malignancy in 6 patients; 2 of these originated in the thigh, 2 in the retroperitoneum, 1 in the mesentery, and 1 in the ileum. Seven tumors showed aggressive growth without known metastases.

The histopathological picture exhibited by the tumor was complex. The cells were not uniform in size or shape, the formation of connective tissue fibers was variable—sometimes none among the tumor cells, sometimes a few, occasionally many were formed—and the blood vessels often were hard to detect. There was only one relationship that was constant; in all the tumors there was a profuse proliferation of obvious or occult capillaries, each one surrounded by a thin or thick connective tissue sheath, outside of which were the characterizing tumor cells that vary so much in their appearance. In parts of some tumors, even the capillaries would seem to disappear, although never in all parts of any given tumor.

From the present study, the writer concludes that the 25 tumors in this group form a definite clinical and pathological entity.—*F. R. McCrea, M.D.*

Antoni, Nils, and Lindgren, Erik. Steno's experiment in man as complication in lumbar aortography. *Acta chir. Scandinav.*, 1949, *98*, 230–247.

This paper is concerned with a hitherto unreported complication of aortography. In 1948 a fifty-eight year old white male was subjected to aortography because of arteriovascular abnormalities in both extremities. The technical procedure employed in this instance did not differ essentially from that described elsewhere for aortography, with the exception that a pillow was placed under the upper part of the abdomen, in an attempt to partially compress the aorta against the spinal column, thus facilitating aortic puncture. This particular procedure had been used by the authors in a number of previous cases without evident disadvantageous features.

Seventy per cent diodrast was employed as the contrast medium, and in the course of the procedure a certain amount of this was injected perivascularly. After the patient returned to his ward he collapsed. The following morn-

ing when the patient had regained consciousness he noted that he was paralyzed, and anesthetic in the lower extremities. Neurological examination showed absolute paralysis and anesthesia from the level of D12 down. The patient was also incontinent of urine. In several weeks' time the anesthesia had extended up as far as the navel anteriorly, and within a month the patient suffered a spontaneous perforation of the urinary bladder, finally dying of sepsis and bronchial pneumonia, approximately five months after the aortography.

The essential findings at the time of postmortem were pronounced atherosclerosis of the aorta, without evidence of traumatic lesion, and without evidence of thrombus. Examination of the spinal cord showed no evidence of obliterating process or thrombosis in any of the spinal vessels. The anterior roots of the cord and the lumbosacral area and cauda equina were completely denervated, showing diffuse areas of degeneration throughout, while the posterior roots, both close to the spinal cord, and throughout the entire cauda equina were, with few exceptions, relatively well preserved.

The authors are of the opinion that the perivascular injection was of no consequence in this case. To support this, they cite reports of various authors who have noted perivascular aortic injections to have occurred without clinical symptoms. The observations made from the postmortem examination of the spinal cord are explained on the basis of aortic compression. This compression may have resulted from the pillow used under the abdomen in this case, since the patient was an unusually thin, emaciated old individual.

Motor and sensory paralysis of the lower part of the body occurring through compression of the abdominal aorta was first described in 1667 by the Danish anatomist, Niels Steensen, known as "Steno." His fundamental experiments were on rabbits, and have since been repeated innumerable times. The lesion has been produced in other experimental animals, with much difficulty. It has hitherto been unreported in man, in spite of the fact that aortic compression is resorted to, not infrequently, in obstetrical practice.

On theoretical grounds there has been no satisfactory answer as to whether the lesion results from selective occlusion of the arteries supplying the anterior portion of the cord and its nerve roots, or by a higher threshold of sensitivity of the anterior root cells. In the particular case cited, the authors theorize that the arteria radicularis magna, which plays a dominant role in nutrition of the lumbar spinal cord, may have occupied a slightly more caudal site than usual, and thus may have been directly under the point of compression.

In support of their thesis of abdominal aortic compression, the authors also cite a case of an otherwise healthy man, aged thirty-seven, who, during violent vomiting in a highly intoxicated condition, leaned heavily over the railing of a boat, and, in connection with this, developed a spastic paresis of the right leg.—*E. C. Lasser, M.D.*

GENERAL

Dahlin, David C. Amyloidosis. *Proc. Staff Meet., Mayo Clin.*, Dec. 21, 1949, *24*, 637–648.

The author reviews the literature and analyzes 44 autopsied cases at the Mayo Clinic. The cases are divided into secondary (associated with a chronic disease) and primary (not associated with another disease).

The 30 cases of the secondary group conformed to the usual pattern, the renal involvement being the most prominent. Of interest is that 1 of the 2 cases associated with Hodgkin's disease showed very little residual tumor after radiation therapy but died of hepatic and renal failure.

The 8 cases of the primary group showed mainly involvement of the heart and gastrointestinal tract. The amyloid was deposited about the muscle bundles causing their atrophy, in the walls of smaller vessels and subendocardially. Grossly the hearts showed concentric hypertrophy. In the gastrointestinal tract amyloid was present in mucosa, muscularis mucosae and muscularis propria. Deaths in this primary group were either cardiac or hepatorenal.

Three cases were associated with multiple myeloma. The author cautions that multiple myeloma may be obscured by amyloidosis as in 2 of these cases where the myeloma was recognized only after autopsy.

Three cases showed amyloid in the heart only.—*H. J. Klos, M.D.*

Guardabassi, Luigi. Contributo alla conoscenza della sindrome di Besnier-Schaumann-Boeck. (Contribution to the study of the Besnier-Schaumann-Boeck syndrome.) *Radiol. med.*, Dec., 1949, *35*, 948–953.

The author discusses the case of a ten month old male infant who presented a symptom-complex of nodular cutaneous lesions, mediastinal and pulmonary infiltration, and cystic bone changes.

The first roentgen examination of the chest showed evidence of right hilar adenopathy and of an extensive exudative type of infiltration in the right subclavicular region.

In appearance the bone changes in the left hand were those of a tuberculous dactylitis, spina ventosa.

A rapid regression of the lesions was observed in subsequent examinations. At first there was a residual thickening of the hilar shadows and the apperance of cystic bone changes in the affected digits, and, finally, about one year after the initial examination, practically a return to normal.

The author stresses the difficulties in the differential diagnosis of tuberculosis and sarcoidosis.

He prefers not to consider Boeck's sarcoid as a distinct disease entity, but as a syndrome, in which tuberculosis may not be proved, but cannot be excluded.

Of special note in this case is the rarity of the Besnier-Schaumann-Boeck syndrome in early infancy.—*A. A. Blasi, M.D.*

Bamatter, F., and Babaiantz, L. La sémiologie radiologique de la toxoplasmose et de l'histoplasmose. (Résumé.) (Roentgenologic semeiology of toxoplasmosis and histoplasmosis.) *Radiol. clin.*, Sept., 1949, *18*, 273–275.

Although differing in their etiology and organotropism, the two conditions produce certain similar roentgen signs.

The following are the principal biochemical findings:

The toxoplasmosis is caused by the protozoan *Toxoplasma*, which is gram-negative; affects the human and laboratory animals; is transmitted to the human directly or indirectly from domesticated animals (dog, cat, rabbit, hare, pigeon); has an affinity for the central nervous system and the eye (encephalomyelitis, chorioretinitis) rarely it also involves the skeleton and certain viscera (lung, heart, intestines, etc.); it occurs everywhere and is biologically diagnosed by the neutralization test (serum of infected individuals) and by the methylene blue dye test.

The histoplasmosis is caused by the *Histoplasma capsulatum*, which is gram-positive; affects the human and animals (dog); its mode of transmission to the human is unknown; has an affinity for the reticulo-endothelial system with predilection for the lungs (miliary form, or pneumonic form sometimes resulting in abscess formation); it also produces hepatosplenomegaly, lymphadenopathy, anemia, leukopenia, arthritis, and rarely involves the kidneys, adrenals, pancreas, and thymus; it occurs in America predominantly in the Central States, and rarely in Africa and is diagnosed biologically by the cutaneous test with histoplasmin.

Roentgenologically, toxoplasmosis is characterized by cerebral calcifications formed in the necrotic zones of the encephalomyelitis. They may appear as solitary or multiple foci and may assume various forms usually located in the vicinity of the ventricular cavities or being scattered throughout the brain. In a large proportion of the cases the calcifications are already present in the newborn (congenital or acute forms). Ordinarily, however, they are not discovered until later in life, either by accident or in the presence of chorioretinitis suspected of being of toxoplasmic origin. The intracranial calcifications are often associated with other craniocerebral anomalies, such as microcephaly, hydrocephaly, various degrees of atrophy of the brain and even hyperostosis of the skull. Very exceptionally, there may also be an involvement of the lungs, resembling interstitial pneumonitis.

In histoplasmosis the pulmonary alterations constitute the most important roentgen findings, either in the acute, or the protracted stage of the disease, or as sequelae later in life. In the active period one may encounter the exudative form of a parenchymatous or interstitial pneumonia which gradually undergoes reparation, or the complex primary form comparable to a primary tuberculous infection, or the multiple disseminated form resembling miliary tuberculosis. Later, multiple or generalized nodular calcifications dominate the picture. It may be said that the discovery of pulmonary lesions of histoplasmic origin during the last few years has revolutionized, especially in America, the interpretation of the calcifications formerly considered as tuberculous in nature. A positive histoplasmin and a negative tuberculin test are important differentiating factors. Occasionally histoplasmosis also involves the joints producing a picture not unlike that seen in tuberculous arthritis.—*T. Leucutia, M.D.*

Looney, J. M., and Stein, Tobias. Coccidioidomycosis; the hazard involved in diagnostic procedures, with report of a case. *New England J. Med.*, Jan. 19, 1950, *242*, 77–82.

Coccidioides immitis in the laboratory is one of the most hazardous agents with which one can deal. A review of the literature of accidental infections caused by handling *C. immitis* cultures in the laboratory revealed 8 cases of infection showing clinical manifestations of the disease with 1 death, and 25 cases of infection indicated by positive skin reactions.

The authors include a detailed report of a twenty-eight year old Negro hospital laboratory technician who developed an acute respiratory form of coccidioidomycosis followed by widespread dissemination of the infection. Two or three weeks before the disease became evident the patient had spent thirty to forty-five minutes studying some old cultures of *C. immitis* at close range with a magnifying glass.

Chest roentgenograms early in the course of the disease showed hazy parenchymal infiltration throughout the left lung and a small patch of increased density in the right apex. The left leaf of the diaphragm was moderately elevated. The patient soon developed considerable enlargement of the mediastinal lymph nodes. About six months following the onset of the disease, destructive lesions were discovered in the metacarpal and metatarsal bones. Serosanguineous material from these lesions demonstrated numerous spherules of *C. immitis* on direct smear. There was a gradual subsidence of lung lesions and slow improvement in the bone lesions over a course of fifteen months.

The laboratory findings are most important in establishing a diagnosis of coccidioidomycosis. A definite early diagnosis can be made only by the recovery of typical spherules from the sputum or from biopsy material. Cultures grow well on Sabouraud's agar and have a typical appearance, but a definite diagnosis depends on the identification of chlamydospores in older growths. The study of such growths in the laboratory is an extremely hazardous procedure and should be absolutely forbidden. The complement fixation test is an invaluable aid in diagnosis. A high titer, 1:32 or more, in a patient's serum indicates dissemination of infection. A persisting high titer means continued activity, whereas a fall in titer parallels subsidence of infection. The skin test must be interpreted with care because it may be four weeks following initial infection before the test is positive, and it may be negative at various times during the course of the disease.

There is no specific treatment for the infection. Roentgen therapy is reported to be beneficial in the treatment of the bone lesions.—*J. R. Hannan, M.D.*

Berke, R., Schomer, A., and Bass, H. E. Residual cavities in pulmonary coccidioidomycosis; follow up studies. *Dis. of Chest*, Jan., 1950, *17*, 84–94.

Four cases of residual pulmonary cavitation following primary coccidioidal infection are reported. A period of five to seven years had elapsed since the time of exposure, the patients were generally asymptomatic and roentgenographic examinations of the chest showed little or no change during a period of two to five years of observation.

The authors present three diagnostic criteria for establishing a diagnosis of coccidioidal infection: (1) a history of residence in an endemic area, (2) a positive coccidioidin skin test, and (3) persistence of residual pulmonary lesions showing little or no change. The recovery of the causative fungus, *Coccidioides immitis*, is not essential for establishing the diagnosis and the presence of a positive tuberculin test does not militate against the diagnosis of coccidioidomycosis.

The residua of pulmonary coccidioidal infection are essentially benign non-contagious lesions, and therapy should therefore be conservative.—*G. Lavner, M.D.*

RADIOISOTOPES

Hahn, P. F., and Carothers, E. L. Use of radioactive colloidal metallic gold in the treatment of malignancies. *Nucleonics*, Jan., 1950, *6*, 54–62.

This is a review article summarizing the authors' researches on "infiltration radioactive isotope" therapy which have extended over a period of years. The advantages, real and apparent, in the use of gold^{198} are well outlined. Ready availability, ease and economy of production in the chain-reacting uranium pile, ability to vary concentration of the colloid, non-absorbability of the gold^{198} and the resulting relative homogeneity of radiation in a local area, combined with its short half-life and its

predominantly beta radiation, make it appear to be a hopeful addition to the therapeutic armamentarium.

A good bibliography, covering the important contributions to this new field, is appended.—*J. W. Karr, M.D.*

Bernier, Joseph L. The effects of atomic radiation on the oral and pharyngeal mucosa. *J. Am. Dent. A.*, Dec., 1949, *39*, 647–657.

Studies have been made of the effect of ionizing radiation from atomic bomb explosions at Hiroshima and Nagasaki on the oral and pharyngeal mucosa in an unstated number of victims. Data are scanty in those receiving an initially lethal dose; persons exposed to a lethal dose having a delayed death, and those receiving a sublethal dose have been studied more carefully. The clinical symptoms in this latter general group began seven to thirty days after the explosion and consisted of diarrhea, purpura, fever, leukopenia and anemia. The oral symptoms were those of hemorrhagic gingivitis usually associated with tonsillitis, pharyngitis and laryngitis—essentially an agranulocytic angina. Complete or partial elimination of peripheral leukocytes followed by the entrance of pathogenic organisms produced the ulcerating lesions.

Histopathologically the oral epithelium shows extensive vacuolation of the individual epithelial cells with non-uniform shrinkage of the cell nuclei. The melanin pigment, normally present to some degree among the Japanese, is abnormally distributed, often residing in the cells of the stratum malphigii and stratum granulosum. Mitotic figures are almost completely absent. The stratum corneum is separated from the underlying stratum granulosum and shows extensive necrotic changes. The tongue exhibits similar changes in the epithelium plus considerable edema of the epithelium and underlying tissues.

The tonsil reveals intermittent necrosis of the epithelium and eradication of the lymphoid elements. In the latter areas, necrosis was complete with a notable lack of the usual polymorphonuclear leukocyte border between the necrotic and non-necrotic zones.

It is noted that the histopathologic changes in the oral cavity and pharynx can be likened to those which take place in other regions of the gastrointestinal tract, and clinically are more accessible to study.—*Harold Fulton, M.D.*

MISCELLANEOUS

Williams, Katherine. Discussion on the physical, cytological and medical aspects of protection from ionizing radiations with special reference to the use of high voltage X-rays and radioisotopes. *Proc. Roy. Soc. Med.*, Nov., 1949, *62*, 923–927.

The primary responsibility for protection lies with the people who plan the physical installation. The types of protection over which the worker has no control are built-in shielding, enclosure of processes and ventilating systems. Protective measures for high voltage roentgen rays and other high energy radiation differ quantitatively rather than qualitatively from those with less powerful machines. Distance and shielding are the two most important factors in protection.

Education of workers in the nature of health hazards is essential. The success of protective clothing, eyeshields and respirators depends upon the cooperation of the workers who use them. Proper techniques in handling of radioactive material must be observed to avoid hazardous exposure. Points of technique such as control of spills, prevention of over-exposure of the hands and other parts of the body, minimization of contamination of working surfaces and room air are discussed. The need for constant monitoring of the working area and protection of workers in contiguous rooms is emphasized.

The success of any radiation control program is measured by the health of the personnel as regards radiation effects. A careful pre-exposure medical examination followed by subsequent routine examinations is a requisite of an adequate personnel safety program. Peripheral blood examinations provide a good index of over-exposure to radiation. The cytological changes in the peripheral blood are briefly discussed. The significance of these changes is not entirely known.

Internal deposition of radioactive material may be determined by laboratory tests. Two examples are the estimation of radon in the breath and of uranium in the urine.

The need for personnel skilled in handling radioactive material, enforcement of proper techniques, adequate physical installation and the need for medical supervision of personnel are stressed.

Safe working conditions can be achieved and

no ill effects upon the health of personnel need occur.—*D. R. Bernhardt, M.D.*

Marley, W. G. Physical methods of achieving protection for high energy radiation and radioactive isotopes. *Proc. Roy. Soc. Med.*, Nov., 1949, *62*, 927–934.

It is generally believed that the hazard from inhalation and ingestion of radioactive material is much more serious than that from external radiation largely because of the difficulty of knowing when exposure has occurred and when material has been taken into the body. Protection is normally achieved by defining a permissible maximum exposure for a particular kind of radiation for a given radioisotope.

Two manuals which give detailed protection measures are *Recommendations of the British X-ray and Radium Protection Committee* and *Introductory Manual for the Control of Health Hazards from Radioactive Materials* available from the Medical Research Council.

The Protection Subcommittee of the British Medical Research Council recommended in 1948 a maximal exposure of 0.5 r per week to roentgen or gamma radiation for an indefinite period. In work with isotopes 0.5 rep of beta radiation in one week should be the maximal exposure, except for the hands which may receive up to 1.5 rep per week. Tolerance for alpha particles should be 1/10 of this. Maximal exposure to neutrons received in one week should not exceed 0.025 rep. It is possible to compute tolerances for certain isotopes which may be inhaled or ingested by taking into account the nature of the radiation and the metabolic processes such as absorption, excretion, location and translocation in the body.

Personnel exposure can be monitored by the wearing of appropriate film badges and the use of hand, foot and clothing monitoring machines. Personnel working with appreciable quantities of radioactive material, or exposed to varying intensities of radiation should carry pocket ionization chambers which can be read quickly. Areas can be monitored by use of equipment appropriate for the particular radiation being measured.

The specific hazards of areas in which chemical and physical research is being carried on are briefly discussed. The general principles of personnel protection in these areas are the same as given above.

As far as possible, radioactive material should be precipitated from waste solution and disposed of as an insoluble residue. Small quantities of beta-gamma isotopes may, however, be disposed of in alkaline solution by washing down a normal sewage system. Animal remains should be incinerated with provision for filtering out radioactive dust. The ash should be disposed of as are other radioactive solid wastes. —*D. R. Bernhardt, M.D.*

Skaggs, L. S. Depth dose of electrons from the betatron. *Radiology*, Dec., 1949, *53*, 868–874.

The depth dose of an electron beam is quite unlike that of roentgen rays. The electron beam will penetrate only to a certain depth characteristic of the energy of the beam. The author explains the factors affecting the shape and depth distribution of ionization of an electron beam.

An account of experimental details is presented. The electron beam from the betatron is unidirectional when it strikes the aluminum foil window, but is rapidly scattered in air outside.

For exact measurements an evacuated collimator was constructed and is described in detail.

A graph of the depth dose of electrons in a water phantom with energies of 16.4, 14.3 and 12.2 mev. show a rapid fall in dosage around 4 to 6 cm. depth.

Isodose curves for 16.4 mev. electrons show different characteristics than familiar roentgen-ray isodose curves.—*E. E. Seedorf, M.D.*